BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

TECHNICAL SPECIFICATION FOR 1.1 KV CROSS-LINKED POLYETHYLENE INSULATED (HEAVY DUTY) ARMOURED PVC SHEATHED UG CABLE.

1.00 **SCOPE:**

The scope of this specification covers the design, manufacture, stage inspection at work, inspection and testing of finish cables at manufacturers works, testing at independent test house, packing, transport and delivery to consignee address of 1.1 KV stranded aluminum, XLPE insulated heavy duty armoured and sheathed power cable for working voltages up to and including 1100 volts underground cables as per specified construction.

2.00 **TECHNICAL REQUIREMENT:**

1.1 KV grade, 90° C rating heavy duty power cable with stranded circular shaped aluminum conductor cross linked polyethylene insulated inner sheathed of extruded PVC, galvanized steel strip armoured and PVC ST-2 overall sheathed.

The cable should be suitable for use in solidly earthed system.

3.00 **STANDARDS:**

3.01 The 1.1 KV UG cable shall, in general meet the requirements of the latest edition of the Bureau of Indian Standards (Generally refereed as IS), IS: 7098 (Part-I) 1988.

3.02 The cables and components in general shall meet the requirements of the following standards with latest amendments or equivalent international standards.

IS:7098 (Part-I)	1988	:	Specification for cross linked polyethylene insulated PVC sheathed cables.
IS:8130	1984	:	Specifications for conductors for insulated Electric Cables.
IS:3975	1988	:	Specification for mild steel wires, strips and tapes for armouring of cables.
IS:10810 (Part 1 to 55)	1984	:	Specification for test on cables.
IS:5831	1984	:	Specification for PVC insulation and sheath of electric cables.
IS:10418	1982	:	Specification for drums for electric cables.
IS:10462	1983	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: part 1 elastomeric and thermoplastic insulated cable.

3.03 The 1.1 KV underground cables shall be manufactured to the highest standard quality, best workmanship with scientific material management and quality control. The bidder shall furnish the quality plan, giving in detail the quality control procedures/management system.

3.04 The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.

3.05 Cable complying with other internationally accepted standards such as IEC, VDE, IPCEA etc., will also be considered in case they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard/standards adopted and furnish a copy of English version of the latest revision of standard(S) along with a tender and shall clearly bring the salient features for comparison.

3.06 In case of any conflict between the referred specification code or standards and this technical specification, the latter shall prevail to the extent of such difference.

3.07 1.1 KV Grade Power Cables to be supplied under this package shall be ISI approved and marked as such. Non compliance of above shall not be accepted.

3.08 However, if cable to be supplied under this specification are manufactured out side India and conform to other internationally accepted equivalent or superior standards the above clause shall not be applicable.

4.00 **DESIGN CRITERIA:**

4.01 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions described in the technical specification.

4.02 Any technical feature, not specifically mentioned here, but is necessary for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under Technical deviations schedule only in the offer made by the bidder, giving technical reasons and justifying the need to incorporate these features.

4.03 For continuous operation of the cables, at specified rating the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90° C under normal operation and 250° C under short-circuit conditions.

4.04 The cables in service will be subject to daily load cycles of two peaks during day, morning peak and evening peak, with reduced loading during the nights.

4.05 The materials used for sheaths shall be resistant to oils, acids, alkalies and chemicals.

4.06 The cables shall have the mechanical strength required during handling and laying.

4.07 The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.

4.08 The cables shall be designed to have a minimum useful life span of forty years.

4.09 Core identification: the core identification for cables shall be provided, by suitable means, like, by application of coloured stripes or any numerals or by printing on the cores as per Clause-10 of IS : 7098.

4.10 For identification coloured stripes, red, yellow & blue colours shall be used to identify the phase conductors & black to identify reduced neutral conductor.

5.00 **MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:**

5.01 Cross linking of the insulation material (Pre compounded polyethylene) shall be conforming to IS:7098 (Part-I).

5.02 The conductor shall be of extruded semi conducting compound. The insulation screen shall consist of the non-magnetic metallic part. The XLPE insulation and the shields for conductor and insulation shall be extruded in one operation.

5.03 Process of curing is of Dry Curing.

6.00 **MATERIALS:**

6.01 Conductor: the conductor shall be of stranded Construction. The material for conductor shall consist of plain aluminium of H2 or H4 grade as per Clause –3 of IS: 8130/1984.

The No. of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS: 8130/1984.

6.02 **INSULATION:** The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS: 7098 Part-I.

6.03 For multicore cables, the interstices at the Centre shall be filled with a non-hygroscopic material. The interstices around the laid up cores shall be covered with PVC compound type S.T.2. This will form the inner sheath for multicores.

ARMOURING: The armour shall be galvanized steel strip, complying with the requirements of IS: 3975.

6.04 **OUTER SHEATH:**

The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, conforming to the requirements of Type ST-2 of IS: 5831 suitable additives shall be added to give anti termite protection.

7.00 **CONSTRUCTION:**

7.01 The general constructional features of the cables shall be as follows:

a) Stranded circular shaped Aluminium conductor. Cross linked polyethylene insulation, cross linked shall be conforming to IS: 7098 (Part-I) 1988 with its latest amendment. Extruded PVC inner sheath. Armour (Galvanized steel strip). Outer PVC sheath with anti-termite treatment.

b) Cables with reduced neutral conductor shall have sizes as given in table-2 of IS: 7098 Part-I.

8.00 **CONDUCTOR:**

8.01 The conductor shall be stranded circular shaped Aluminium wires of H2 or H4 grade plain aluminium wires.

8.02 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.

8.03 Not more than two joints shall be allowed in any one of the single

8.04 Forming every complete length of conductor and no joint shall be within 300mm of any other joint in the same layer. The joint shall be made by brazing silver soldering or electric or gas welding.

8.05 No joints shall be made in the conductor after it has been stranded.

8.06 **INSULATION:** The insulation shall be provided over the conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be confirming of IS:7098 (Part-I).

8.07 **THICKNESS OF INSULATION:** The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 3 of IS: 7098.

8.08 The insulation shall be applied to closely fit on the conductor screen and it shall be possible to remove it without damaging the conductor.

9.00 **LAYING UP OF CORES:**

9.01 For multicore cables, the core shall be laid together with a suitable right hand lay, where necessary the interstices at the centre shall be filled with a non-hygroscopic material.

9.02 Inner sheath for Multi core cables:

9.03 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST-2 conforming to IS: 5831 or equivalent standard.

9.04 The minimum thickness of the inner sheath shall conform to Table 5 of IS: 7098 (Part-I), 1988 or equivalent standard.

9.05 The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.

10.00 **ARMOURING:**

Application

10.01 Armouring shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multicore cables.

10.02 The armour stripes shall be applied as closely as practicable.

10.03 The direction of lay of the armour shall be left hand. For double strip armoured cables, this requirement shall apply to the inner layer of strips. The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer and there shall be a separator of suitable non-hygroscopic material.

10.04 **DIMENTIONS:** The dimensions of galvanized steel stripes shall conform to table 6 of IS: 7098 (Part-I).

10.05 A binder tape may be applied on the armour.

10.06 **JOINTS:** The joints in armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any strip shall be at least 300 mm from the nearest joint in any other armour strip in the completed cable.

11.00 **OUTER SHEATH:**

11.01 The PVC outer sheath with anti termite treatment shall be extruded over the armouring for multi core cables and single core cables.

11.02 The colour of the outer sheath shall be black.

11.03 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 8 of IS: 7098 (Part-I) 1988.

12.00 **IDENTIFICATION:**

12.01 The outer sheath shall have the following information embossed or indented on it, the manufacturer's name or trademark, the voltage grade, the year of manufacture and the letters "BESCOM" 'ELECTRIC'. The identification shall repeat every 300/350 mm along the length of the cable.

13.00 **CABLE DRUMS:**

13.01 Cables shall be supplied in Non returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound and free from defects, wood preservative shall be applied to the entire drum.

13.02 Standard length of each size of power cable to be supplied by the bidder shall be 500/1000 metres. The cable length per drum shall be 500/100 metres. The cable length power drum shall be subjected to a tolerance of $\pm$5% of the standard drums lengths. Acceptance of

smaller lengths of cables are subjected to approval of purchaser. Smaller lengths of less than 100 metres will not accepted.

13.03 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.

13.04 A clear space of atleast 40 mm shall be left between the cables and logging.

13.05 The cable drum shall carry KST marking with the following information stenciled on both sides of the drum. A tag containing the same information shall also be attached to the leading end of the cable.

a. Reference to the Indian Standards.
b. Manufacturer's Name, Brand Name or Trade Name.
c. Purchase's name, contract No. and date.
d. Type of cable and voltage grade.
e. Number of cores.
f. Nominal cross section area of the conductor.
g. Cable code.
h. Length of the cable on the drum.
i. Number of lengths on drum.
j. Direction of rotation of drum (by means of an arrow).
k. Net and gross weight.
l. Country of manufacture.
m. Year of manufacture.

13.06 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cables ends shall be scaled with good quality heat shrinkable caps so as to eliminate ingress of water during transportation and erection.

14.00 **QUALITY ASSURANCE PLAN:**

14.01 The successful bidder shall submit following information to the owner:

14.02 Test certificates of the raw materials and bought out accessories.

14.03 Statement giving list of important raw materials, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

14.04 List of manufacturing facilities available.

14.05 Level of automation achieved and lists of areas where manual processing exists.

14.06 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

14.07 List of testing equipments available with the bidder for final testing of equipment along with valid calibration reports.

14.08 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

14.09 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

15.00 **Guarantee**

15.01 The supplier of cables shall guarantee overall satisfactory performance of the cables.

15.02 At least three copies of type test reports shall be furnished. One Copy shall be returned duly certified by the owner, only after which the commercial production of the concerned material shall start.

15.03 Copies of acceptance test reports shall be furnished in at least Three (3) copies. One copy shall be returned duly certified by the Owner, only after which the materials shall be dispatched.

15.04 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

15.05 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

16.00 **Inspection**

16.01 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where cable, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

16.02 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain cables manufactured in 3-4 consecutive weeks.

16.03 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

16.04 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the later case also the material shall be dispatched only after satisfactory testing specified here in has been completed.

16.05 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection, if such materials are later found to be defective.

17.00 **QUALITY CONTROL:** The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

The Bidder shall arrange for inspection by the purchaser, during manufacture, if so desired by the purchaser to verify the quality control process of the Bidder.

18.00 **TYPE TESTS:**

18.01 Not withstanding that type test have been conducted earlier, the successful bidder the each member of consortium shall conduct all type tests as per IS: 7098 (Part-I) 1988, with upto date amendments or equivalent international standard and supplies made only after approval of test reports from the purchaser.

18.02 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

18.03 The successful bidder shall give FIFTEEN days advance notice for inspections and witnessing of tests by the purchaser or his representative.

18.04 The owner reserves the right to get the cable type tested at any of the BESCOM recognized testing house/laboratory at his own expense for any further tests to verify the compliance with the specifications and to reject the cables in case they are found not satisfying the qualifying requirements as per relevant standards.

18.05 The following type tests will be conducted on the cable as per IS: 7098 (Part-I) .

a Test on conductor.
b Test on armour strip.
c Test for thickness of XLPE insulation and inner & outer sheaths.
d Physical test on XLPE insulation.
e Physical test on out sheath.
f Insulation resistance (volume resistivity) test.
g High voltage test.
h Flammability test.

18.06 ACCEPTANCE TEST:
The sampling plan for acceptance test shall be as per IS: 7098 (Part-I) 1988.

18.07 The following shall constitute the acceptance test.

a) Tensile test for aluminium.
b) Wrapping test for aluminium.
c) Conductor resistance test.
d) Test for thickness of insulation.
e) Test for thickness of inner and outer sheath.
f) Hot-set test for insulation.
g) Tensile strength and elongation at break test for insulation and sheaths.
h) High voltage test.
i) Insulation resistance (Volume resistivity) test.

19.00 **ROUTINE TEST:**

The following shall constitute routine tests:

a) Conductor resistance test.
b) High voltage test.

20.00 **SEALING OF CABLE ENDS ON DRUMS:**

20.01 The cable ends shall be sealed properly so that ingress of moisture is completely prevented.

20.02 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi-conducting layer on the cores may be removed for about 2mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

20.03 The multi cores should have an overall heat shrinkable cap with adequate end clearance and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

20.04 **CABLE LENGTHS:**

The cables shall be supplied in continuous lengths of 250-500 Mtrs in case of multi core cables with a tolerance of ±5% of drum length.

21.00 **GUARANTEED TECHNICAL PARTICULARS:** Guaranteed technical particulars of the cables to be supplied is enclosed.

22.00 **SCHEDULE OF DELIVERY:** The details regarding the delivery schedule are given in the Purchase Order/Dispatch instructions.

23.00 **DRAWING & LITERATURE:** The following shall be furnished along with the tender.

a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.

b) An illustrated literature on the cable, giving technical information on current ratings, cable constants, short circuit ratings, derating factors for different types of installation, packing date, weights and other relevant information.

General Manager El,
Procurement, BESCOM

BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

1.1kV LT AB Cable as per IS 14255:1995 with high quality class XLPE Insulation		
SL. No.	**Particulars**	
	Name of the Manufacture	
1	Standard/specification	
2	Size of Aerial Bunched cable	
3	**CONDCUTOR**	
3.1	phase conductor - Alu portion	
	i) Material of conductor	Aluminium wire(H2 or H4)
	ii) Applicable standard	IS 8130
	iii) Geometrical area of cross-section of bare conductor(Sq.mm)	
	iv) No. of strands	
	v) Nominal diameter of strand(mm)	
	vi) Maximum DC resistance of the conductor at 20°C	..... (Resistance test conductor to 5mtrs sample)
	vii) Diameter of bare conductor (mm)	
3.2	**Street Light conductor-Alum. Portion**	
	i) Material of conductor	Aluminium Alloy(AAAC)
	ii) Applicable standard	IS 398 Part IV- 1994
	iii) Geometrical area of cross-section of bare conductor(Sq.mm)	
	iv) No. of strands	
	v) No. diameter of strand in mm	
	vi) Maximum DC resistance of the conductor at 20°C	..... (Resistance test conductor to 5mtrs sample)
	vii) Diameter of bare conductor (mm)	
3.3	**Messenger/actual conductor-AAA portion**	
	i) Material of conductor	
	ii) Applicable standard	
	iii) Geometrical area of cross-section of bare conductor(Sq.mm)	
	iv) Number of strands	
	v) Nominal diameter of strand(mm)	
	vi) Maximum DC resistance of the conductor at 20°C	
	vii) Diameter of bare conductor (mm)	
	viii) Lay Ratio	
	ix) Tensile strength (min)/breaking load (KN)	
4	Sampling batch for test	
5	**Phase conductor - Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
5.1	**Street Light conductor - Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
5.2	**Messenger/neutral- Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
6	**Complete AB cable**	

	i) Code or method of cable identification	Phase conductors in Black color, Ridges to be provided as 1,2,3 for identification as per clause no.8 of IS 14255/1995
7	**Tests on XLPE Insulation**	
7.1	**Hot set test**	
	a) (Max. elongation under load)	
	b) (Max.permanent Elongation After cooling)	
7.2	a) Min Tensile Strength	
	b) Min Elongation	
7.3	Water Absorption test :a) Max. water absorbed	
7.4	Carbon Black Content Shall be ranging	
8	Cable mass (Kg/Km) (Not less than specified value in the Tech Spec)	
9	**Electrical Data:**	
	i) Short Circuit current for 1 Sec. Max (KA)	
	ii) Current carrying capacity (amps) at various ambient temp.deg.of 10°C, 20°C, 30°C, 40°C & 50°C	
10	**BENDING RADIUS OF CABLE:**	12D
11	Scheme of the identification of the cable	marking shall be embossed on the insulated phase conductors for identification: letters **BESCOM OH-UG Cable Project; Ref P.O & Date** in addition to manufacturer's name or trade mark year of manufacture at regular intervals of not more than one meter. The cables with cross linked polyethylene insulation shall be identified throughout the length of the cable by the legend 'XLPE 90'.

TECHNICAL SPECIFICATION FOR 11 KV COMPACT RING MAIN UNITS (Non DAS) FOR OUT DOOR USE IN 11 KV UNDERGROUND CABLE SYSTEM

1.0 SCOPE:

1.1 This specification covers the design, manufacture, testing and delivery of "11 kV Outdoor Type Prefabricated Compact Switching Stations", hereinafter called "Compact RMU" (Non DAS) to be erected in the 11kV distribution system.

1.2 The Compact RMU shall be suitable for main cable network of 630 Amps and loop cable network of 400 Amps and shall consist of the following:

(a) Two Load Break Switches (ODs) with Earthing Switches for incoming and out going main loop 11 kV XLPE cables of size 95/240/400 square millimeter cross section aluminum conductor,

(b) One/Two/Three Circuit Breaker (VL) with Earthing Switch for connecting Distribution loop 11 kV XLPE cables of size 95/240/400 square millimeter cross section aluminum conductor, and

(c) Provision for adding more number of Circuit Breakers (VL) of the type mentioned in item (b).

1.3 The bidder should quote separate costs for the unit comprising of two Load Break Switches for Incomers along with one Circuit Breaker, and additional Circuit Breakers. The purchaser shall select a suitable configuration compounding these units at the time of placing the order.

1.4 These shall comply with the following system parameters:

1. Nominal System Voltage: 11 kV
2. Highest System Voltage: 12 kV
3. Rated Voltage: 12 kV
4. System frequency: 50 Hz
5. Number of Phases: Three Phase - Three Wire

1.4(b) The RMU shall be suitable for outdoor installation in 11kV system and shall be with 630Amps insulated copper/Aluminum Bus Bars.

1.5 The Load Break Switches with Earthing Switches, and the Circuit Breakers with Earth Switches used in the Compact RMU shall be of SF_6 gas filled type using SF6 / Vacuum circuit breaker meeting the following criteria:

1. Lightning Impulse Withstand Voltage
   (a) Phase - to - Phase & Phase - to - Earth: 75 kVp
   (b) Across the Isolating distance: 85 kVp
2. Power Frequency Withstand Voltage:
   (1) to earth, between poles and across opening switch device: 28 kV rms for 1 minute
   (2) across isolating device: 32 kV rms for 1 minute
3. Rated Short Time Withstand/Breaking Current: 20 kA rms
4. Rated duration of Short Circuit: 3 seconds
5. Rated Normal Current: 630 Amps rms
6. Load Break Switches :
   (a) Rated Short Circuit making capacity: 50 kA peak at rated voltage (both the earth switches and Load Break Switches)
   (b) Rated Load Interrupting Current: 630 A rms
   (c) Rated Cable Charging Interrupting Current: 25 A

1.6 The configuration of the Compact RMU shall be generally as per Figure 1 enclosed. Provision should be made to extend the Compact RMU by installing additional Circuit Breakers of similar design.

1.7 All the switchgear shall be capable of withstanding the specified current without any damage being caused, in accordance with the latest versions of IEC 60694.and IS 3427.

2.0 SERVICE CONDITIONS:

2.1 The equipment shall be suitable for installation at location having the following climatic conditions:

(a) Annual average ambient temperature: 40°C
(b) Maximum ambient temperature: 45°C
(c) Temperature rise due to solar absorption: 10°C
(d) Maximum relative humidity: 95%
(e) Annual rainfall: 1000 to 1200 mm
(f) Duration of rainy season: May to October
(g) Altitude: up to 1000 M above MSL
(h) Environmental condition: The RMU should be compact Modular in construction and suitable for outdoor application without any further covers

or enclosure. The RMU shall be tested for weather proofing tests as per IS & IEC. The RMU's are exposed to sun and rain by the side of road and subject to dust and Pollution from the heavy vehicular Traffic.

3.0 STANDARDS:

3.1 The equipments and all the components shall meet the requirements of the latest versions of the following standards:

(a) IS 3427: AC metal enclosed switchgear and control gear for rated voltages above 1 KV and upto and including 52 KV.
(b) IS 12063: Classification of degrees of protection provided by enclosures of electrical equipment.
(c) IS 9920 (Parts 1 to 4): High Voltage Switches.
(d) IS 9921 (Parts 1 to 5): Specification for AC disconnectors and earthing switches for voltages above 1000 V
(e) IS 13118: HV AC Circuit Breakers.
(f) IS 12729: General requirements of switchgear and control gear for voltages exceeding 1000 V
(g) IS 10601: Dimensions of terminals of HV Switchgear and Control gear.
(h) IEC 1330: High voltage/Low voltage prefabricated substations
(i) IEC 60694: Common clauses for MV switchgear standards.
(j) IEC 6081: Monitoring and control.
(k) IS 2705: Current Transformers
(l) IS 8686: Specification for Static Protective Relays
(m) IEC 62271-200 standards for high voltage metal clad switchgear up to 52 kV.
(n) IS 9431: Busbar support Insulator

3.2 In case of equipments and/or components of the same conforming to any other International standards, which are equal to or higher but not less rigid than the standards and specifications mentioned above, the same should be clearly indicated and a copy of such standards shall be furnished along with the offer. Whenever such standards are in any other language other than English, an English translation of the same shall also be furnished.

4.0 DESIGN:

4.1 The compact RMU shall be designed to operate at the rated voltage of 12 kV. It shall consist of Two numbers of 630 Amps SF_6 Insulated Load Break Switches as Incomers and The required numbers of 400 Amps Vacuum or SF_6 Circuit Breakers suitable for 630 Amps main network for control of 11 kV loop circuits consisting of several distribution transformers; total load of which do not exceed 3500 kVA. It shall also include, within the same metal enclosure,

earthing switches for each Load Break Switch and Circuit Breaker for earthing each of the devices. Suitable fool-proof interlocks shall be provided to these earthing switches to prevent its inadvertent or accidental closing when the circuit is live and the concerned Load Break Switch/Circuit Breaker is in closed position. Provision should be made for extension of few more Circuit Breakers or Load Break Switches on a future date. In case of gas filled units, the switchgear and busbars shall be contained in stainless steel enclosure filled with gas at relative pressure between 0.2 and 0.8 bar to ensure adequate insulation and safe operation. The assembly should not require further gas processing during its expected life of operation of 30 years as per Clause GG 2.3 and 3.3 of IS 3427. The degree of protection required against environment shall be not less than IP 54 of IS 12063. The Compact RMU shall have atleast an IP54 Protection Index as per IS 12063 against dust and splashing of water. The active parts of the switchgear shall be maintenance free and the Compact RMU shall be of low-maintenance type.

4.2 The tank shall be made of suitable stainless steel of minimum 2 mm thickness or Metallised Cast Resin of adequate thickness and shall be internal arc tested.

4.3 The Compact RMU shall be suitable for mounting on its connecting cable trench. A suitably sized nameplate clearly indicating its functional units and their electrical characteristics shall identify each unit. The positions of the different devices shall be clearly visible to the operator on the front of the compact RMU and the operations shall be clearly visible. The compact RMUs shall be such that access to live parts shall not be possible without the use of tools.

4.4 All the associated switchgear shall be assembled on an outdoor panel with suitable housing arrangement and interconnection for busbars, Current Transformers, relays etc. The cubicle shall be metal enclosed with sheet of not less than 2-5 mm thickness and fitted with pressure relief arrangement directed away from the operator. The individual panel shall have a separate front door, which can be locked with a padlock. The scope of supply includes panel interconnecting bus strip bolts and nuts, insulating compounds. The ends of the busbars shall be fully insulated to prevent flashover to panel cover. The side cover shall be insulated and suitable gasket shall be provided and

made waterproof and vermin-proof. The outdoor panel shall have to be provided with housing having rainwater sheds and tropicalized.

4.5 The fabricated parts shall be initially degreased using an alkaline degreaser. They shall then be picked and dipped in phosphating solution. The surface shall be painted with zinc chromate primer and dried for about 24 hours. Dents and scratches, if any, shall be smoothened out with suitable compound. After the surface has been hardened, the compound shall be dry0scrubbed with emery cloth to remove any unevenness. The compound shall then be wet flattened using water proofing emery and dried. The first coat of paint shall then be spray painted and all the above procedure shall be repeated till a perfect surface is achieved. Three coats of paint of the required shade shall then be sprayed finally.

4.6 The exterior finish shall be Grey colour and the shade shall be got approved before taking up manufacture. Due regard shall be given the climatic conditions under which the equipment has to work. The ambient temperature may vary from 10°C to 45°C and due to exposure directly to sun the panel temperatures will be much higher than this. For this purpose, an additional temperature rise of 10°C shall be designed to prevent ingress of dust and moisture and accidental contact with live parts and conform to IP54 and IP2X of IS12063.

4.7 The following accessories shall be provided for each RMU:

i. Locks for all the doors with two sets of keys and one master key
ii. Earth bus of GI earthing plates 50x6mm run throughout the panel
iii. Base channel with foundation bolts.
iv. Wire guard mesh on front door and rear side for preventing pasting of papers etc.
v. Ventilating louvers with weld mesh
vi. Danger plate, caution boards, nameplates, rating plates, protection for live parts etc.
vii. All the required items for the satisfactory operation whether specifically mentioned or not.

4.8 The design shall incorporate such features to prevent any accidental opening of the earth switch when it is in closed position. Similarly accidental closing of Circuit Breaker or Load Break Switch shall be prevented when the same is in open position from the releasc of any latch or spring in tension due to vibrations caused externally or internally and shall prevent accidents.

5.0 EARTHING:

5.1 There shall be continuity between metallic parts of the Compact RMUs and cables so that there is no dangerous electric field in the surrounding air and safety of the personnel is ensured. The frames should be connected to the main earth bars. The cables should be earthed by an Earthing Switch having the specified short circuit making capacity. The Earthing Switch shall be operable only when the main switch is open and suitable mechanical fail-proof interlock shall be provided for the same.

5.2 The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw, suitable for the specified earth fault conditions. The diameter of the clamping screw shall be atleast 12 mm. The connection point shall be marked with the earth symbol. The flexible connections between the earthing blade and the frame shall have a cross section of atleast 50 square mm copper or equivalent in aluminum.

5.3 The Earthing Switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast acting mechanism, independent of operator's action. Mechanical interlocking system shall be such that the operating staff shall be prevented from closing the Earthing Switch when the main switch is closed.

6.0 INCOMER LOAD BREAK SWITCHES:

6.1 The Load Break Switches shall be maintenance free. The position of power contacts and earthing contacts shall be clearly visible on the front of the Compact RMU. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions, viz. Open, Closed and Earthed and shall be constructed in such a way that natural interlocking prevents unauthorized operations. The

switches shall be fully assembled in the factory. Manual opening and closing shall be driven by a fast-acting mechanism, independent of operator's action.

7.0 CIRCUIT BREAKERS:

7.1 The Circuit Breakers shall be maintenance free. The position shall be clearly visible on the front of the Compact RMU. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions, viz. Open, Closed and Earthed and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested and inspected in the factory.

7.2 An operating mechanism can be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There should be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the "OPEN" and "CLOSED" position of the Circuit Breaker shall be provided. The breakers of the same type and rating shall be interchangeable.

7.3 When the Circuit Breaker closing mechanism is of the spring operated type, it should not be possible for the Circuit Breaker to close until the spring is fully charged and the associated charging mechanism is fully ready for closing. Wherever external spring charging handle is required to charge the spring, it should be ensured that the same is not allowed to move during the release of its spring energy. Alternately, it should not be possible to release the spring energy till the charging handle is completely disengaged from the mechanism. A visual mechanical indicating device shall be provided to indicate the status of spring viz., "SRING CHARGED" or "SPRING FREE". It shall be possible to charge the spring when the Circuit Breaker is closed and if the spring is released the Circuit Breaker should not open; nor this operation result in any mechanical damage to the component of the Circuit Breaker or its operating mechanism. Alternatively, fast acting reflex mechanism for Circuit Breakers is also acceptable.

7.4 The Circuit Breaker shall be provided with a suitable protection system that will operate without any auxiliary power supply under fault conditions. The protection system shall comprise of three numbers of Current Transformers and a self-powered electronic relay. The Current Transformers and Numerical Self-powered Relay with display Relays shall conform to IS 2705 and IS 8686 respectively. The over current protection shall have two separate settings, one low setting with IDMT and the other high setting of definite time type. The earth fault protection shall operate by residual current measurement using the sum of sensory secondary currents. The relay shall be self-powered to operate and trip the Circuit Breaker. The relay shall be provided with a testing port in front of the relay. The OC Relay shall have current settings 10% to 120% in steps of 10%. OC & EF relays shall have 'Inrush bypass facility' to avoid nuisance tripping due to transformer inrush current. The EF relays shall have current settings 5% to 40% in steps of 5%. The relays shall atleast support 3 sec, 1.3 sec & extremely inverse curves along with adequate high-set facility. Self-powered Electronic/Numerical relays shall be used.

8.0 CABLE TERMINATION:

8.1 The bushing should be conveniently located for workings with cables specified and allow for the termination of these cables in accordance with the prevailing practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601. A non Ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the Compact RMU. Suitable locking arrangement of the Circuit Breakers, Earthing Switches and Load Break Switches with padlocks in the "Open" or "Closed" position shall be provided.

8.2 A permanent "Cable Alive" indication as per IEC 61958 shall be provided for each cable using a capacitance voltage divider.

8.3 It must be possible to test the core or sheath insulation of the cables without deenergizing the remaining section of the Compact RMU without accessing the cable compartment and without disconnecting the cable.

9.0 SAFETY OF EQUIPMENT:

9.1 In case of SF_6 filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the rear part of the enclosure so that the gas will be released away from the operator.

9.2 All manual operations shall be carried out on the front of the Compact RMU. The effort required to be exerted on the lever by the operator shall not exceed 250 N.

10.0 FRONT PLATE:

10.1 The front plate should include a clear mimic diagram indicating the functions. The position indicators shall correctly depict the position of the main contacts and shall be clearly visible to the operator. The lever operating direction shall be clearly indicated.

11.0 Current Transformers

A panel shall be provided in each load break switch enclosure to mount a three-phase, single-core, CT for metering purposes. A similar panel shall be provided in each circuit breaker enclosure to mount a three-phase, single-core, CT for protection purposes. CT access for maintenance or any other purpose shall be from the front, back, or top of these panels.

The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.

Further characteristics and features distinguishing CTs used for metering from CTs used for protection are listed as follows:

CTs for Metering:

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 400-200-100/1 A
- Accuracy Class: 0.5

CTs for Protection:

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 400-200-100/1 A
- Accuracy Class: 5 P 10

The RMU's other CTs, i.e., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI.

12.0 Potential Transformers

Three (3) potential transformers shall be provided. The burden per transformer shall be no more than 50 VA and the voltage ratio shall be 11000/110 V. The accuracy class shall be 0.5. HRC fuses shall be provided on the HV side.

The PTs shall be of cast epoxy-resin construction, and they shall conform to IS 3156. Their design and construction, in particular, shall be sufficiently robust to withstand the thermal and dynamic stresses during short circuits.

13.0 FAULT PASSAGE INDICATORS (FPI):

These shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The unit should be self-contained requiring no auxiliary power supply. The FPI shall be integral part of RMU, shall be capable of indicating the passage for both phase and earth faults. The FPI shall have ***LCD/LED display*** and automatic reset facility.

14.0 Multi-Function Meter

The RMU main incoming and outgoing OD circuits shall be equipped with Intelligent Electronic Devices (IEDs) in the form of communicable multi-function meters capable of providing distribution system voltage, current, power factor, power, and energy readings.

Operational Features

The multi-function meters shall have an accuracy class of 0.5 and shall provide data on an RS 232/485 communications port using the MODBUS protocol.

Each multifunction meter shall have the following minimum features:

- Measurement, display, and communications capability of up to 31 parameters
- THD measurement and power quality data
- True rms measurement
- Digital communications
- Fully programmable PT and CT ratios
- Simple menu driven interface
- High quality LED display
- Able to monitor:
  - Voltage: line-to-line and line-to-neutral
  - Current: phase and neutral
  - Frequency
  - Power factor
  - Power (active, apparent, and reactive)
  - Energy (active and reactive)
  - Total harmonic distortion

Specifications

The following table summarizes the specifications applicable to the multi-function meter.

Table Error! No text of specified style in document.**-1: Multi-Function Meter Specifications**

Parameter	Value
Input Voltage: Nominal input voltage (AC rms) Max continuous input voltage	57.7 – 277 V L-N, 100 - 480 V L-L 120% of nominal value
Input Current: Nominal input current System CT primary values Max continuous input current	1 or 5A AC rms (programmable on site) Standard values up to 4 kA (1 or 5 A) 120% of rated value
Overload Withstand: Voltage Current	2 x rated for 1 sec, repeated 10 times at 10 sec intervals 20 x rated for 1 sec, repeated 5 times at 5 minutes
Operating Measuring	5 to 120% of rated value

Ranges	
Current	5 to 120% of rated value
Frequency	40 to 70 Hz
Power Factor	0.5 lag to 0.8 lead
Accuracy Reference Conditions: Reference temperature Input waveform Input frequency Auxiliary supply voltage Auxiliary supply frequency Power Factor	 23°C ± 2°C Sinusoidal (distortion factor 0.005) 50 or 60 Hz ±2% Rated Value ±1% Rated Value ±1% 0.866 lag to 0.866 lead
Accuracy: Voltage Current Frequency Active Power Re-Active Power Apparent Power Active Energy (kWh) Reactive Energy (kVArh) Apparent Energy (kVAh) Phase Angle and Power Factor	 ±0.5% over 50 to 100% of rated value ±0.5% over 10 to 100% of rated value 0.15% at mid frequency ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% 1 %
Applicable Standards: EMC Immunity Safety IP for water and dust	 IEC 61326 IEC 61000-4-3 (10V/m minimum, Level 3) IEC 61010-1-2001 (permanently connected use) IEC 60529
Environmental: Operating temperature Relative humidity	 -10 to +55°C 0 to 90% non-condensing

15.0 NAME PLATE:

Each RMU and its associated equipments shall be provided with a nameplate legible and indelibly marked with at least the following information.

(a) Name of manufacturer
(b) Type, design and serial number
(c) Rated voltage and current
(d) Rated frequency
(e) Rated symmetrical breaking capacity

(f) Rated making capacity
(g) Rated short time current and its duration
(h) Purchase Order number and date
(i) Month and Year of supply
(j) Rated lighting impulse withstand voltage
(k) D.C. component of current.
(l) Feeder name(Incoming and Out going),DTs Structure name,11000Volts Dangers etc.

NOTE: i) The word rated need not appear on the name plate. Recognized abbreviations may be used to express the above particulars.
ii) Whether the circuit breaker is fitted with closing/tripping devices necessitating an auxiliary supply shall be stated either on the circuit breaker name plate or any other acceptable position.

16.0 TESTS:

16.01 Type test reports for all the type tests required to be conducted as per the standards mentioned in these specifications shall be furnished along with the bid.

16.02 Routine tests and acceptance tests shall be conducted in accordance with these standards in presence of the purchaser's representatives. The contractor shall give atleast 15 days advance notice for witnessing these tests. Copies of test reports of all these tests shall be furnished to the purchaser for approval. Each completely wired Compact RMU shall be tested to ensure all of its protective; control and interlock systems operate satisfactorily. The bidder shall indicate the tests to be carried out in the field after the installation and before commissioning.

17.0 INSTRUCTION MANUALS:

17.01 Six copies of installation, operation and maintenance manuals shall be supplied along with the equipment. Two additional copies of these manuals shall be supplied at the time of commencement of works before the materials are supplied. These manuals shall be complete in all respects furnishing the constructional and operational features of the equipment. The same shall contain all the details and required drawings and/or illustrations along with the overall procedures to enable to identify all the parts and consumable spares, which may have to be identified readily for ordering, purpose.

18.0 DRAWINGS:

18.01 The contractor/supplier shall submit complete sets of drawings and diagrams for approval within 15 days of receipt of the order before proceeding with manufacture. After approval of these drawings, a complete set of reproducible of all the drawings shall be submitted along with six copies of each of the drawings.

19.0 FORMATION OF COMPACT RMU:

19.01 The compact RMU shall be of single busbar outdoor, tropicalized and metal enclosed type in accordance with the relevant clauses mentioned in these specifications. FPI using a core balance Current Transformer shall be provided for the Incomers to assist in identifying the faulty cable section in order to isolate the same.

The RMU is with 2 nos incomers(IN/OUT) are load break switches and one SF6/Vacuum circuit breaker are in a single SF6 chamber as per the specifications.Each RMU shall have the provision for extension on both sides by adding circuit breakers in future at site. The extensible circuit breakers shall be individually housed in separate SF6 gas enclosures. Multiple numbers inside a single gas chamber enclosure are not acceptable.

19.02 The Incomers panel (OD) shall comprise of, but not limited to the following:

1. A triple pole SF_6 Load Break Switch rated 630 Amps or higher, with a rated making capacity
2. Core balance Current Transformer and fault passage indicators.

These shall not require any external Power Supply and must be suitable for unattended places.

19.03 The transformer loop circuit control panels (VL) shall consist of but not limited to the following:

1. A triple pole Vacuum/SF_6 Circuit Breaker rated 400 Amps or higher, with a rated making capacity under fault conditions with short circuit levels of 20 kA or above at 11 kV
2. Manually closing mechanism
3. Numerical relay with display and self powered protection system.
4. Mechanical "ON", "OFF" " Earth" position indication.
5. Manual tripping mechanism
6. Mechanical "Spring Charged", "Spring Free" indicator in case of stored energy devices.

20.0 ACCESSORIES:

20.01 The following accessories shall be provided for each compact RMU:

1. Pad locks for all doors with one set (3 Nos.) Master keys
2. Earth bus formed out of 50X6 mm GI earthing flats
3. Base channel with foundation bolts
4. Danger plates, caution boards, name plates, rating plates etc. as per requirements.
5. Ventilating louvers with weld mesh.
6. Live parts shrouds danger, plates, caution boards, name plates, rating plates etc., as per requirements.
7. Bus bar supports(Porcelin insulator supports) as required
8. All other components, even though not specifically mentioned, but required for the safe operation of the unit.

21.0 INFORMATION TO BE FURNISHED ALONG WITH THE BID:

The following information shall be furnished along with the bid:

1. Completely filled in the "Guaranteed Technical Particulars" as per Appendix 1.
2. Catalogues describing the equipment duly indicating the model.
3. Literature describing the operational features.
4. Typical GA drawings.
5. Type Test Certificates.
6. List of utilities where similar equipments are working.
7. Details of experience.
8. Foundation drawings.

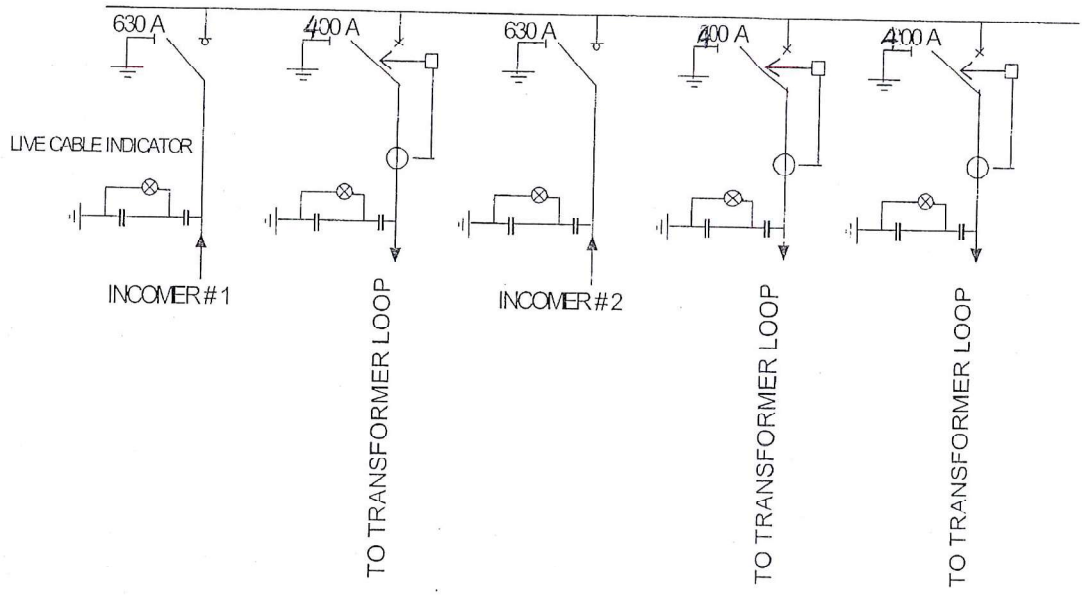

FIG 1 : -SINGLE LINE DIAGRAM OF TYPICAL 11 KV (2 + 3) COMPACT RING MAIN UNIT

BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

ANNEXURE – 1
SCHEDULE OF GUARANTEED PARTICULARS FOR OUTDOOR RMU

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/Model.	
03.	Material used for making the body of the RMU	
04.	Standards of manufacturing	
05.	Whether painting for RMU is done as per standards.	
06.	Whether the enclosure is anti-corrosive	
07.	Whether the RMU metal clad is provided with sufficient space for integration of b) Minimum 2 numbers load break isolators and 1 number SF6/Vacuum Circuit breaker. e) Sufficient space for inspection, testing, etc f) Earthing arrangements g) Sufficient arrangement for future extension with Load break isolators/Breakers	
08.	Maximum withstanding ambient temperature	
09.	Spacing between live part to Earth	
10.	Whether the RMU's are designed to withstand the in all weather conditions (Seashore area, Chemical industries polluted area)	
11.	Period of guarantee of the RMU	
12.	Over all dimensions of the RMU (L x B x H)	
13.	Gauge of the Material used for the fabrication of the RMU	
14.	Whether the RMU is manufactured as per IEC/IS standards to hold SF6 gas without leakage.	
15.	Whether the RMU made provision for sensors for temperature compensated pressure measurement in the relevant gas compartment to monitor the pressure of SF6 gas.	
16.	Whether the RMU is sealed pressure system.	
17.	Weight of RMU complete with operating mechanism.	
18.	RMUs are provided with necessary take off terminals for automation	
19	Whether the gas chamber is made of stainless steel / metalised cast resin.	

ANNEXURE - 2

SCHEDULE OF GUARANTEED PARTICULARS FOR BREAKER

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/Model.	
03.	Material used for making the body of the breaker	
04.	Standards of manufacturing	
05.	Whether the breakers are manufactured as per IEC/IS standards	
06.	Maximum temperature with stand of the breakers	
07.	1)Spacing between live part to Earth inside the breaker 2)Spacing between poles	
08.	Period of guarantee of the breaker	
09.	Rated frequency	
10.	Rated voltage	
11.	Highest system voltage	
12.	Rated current	
13.	Short time current rating with duration	
14.	Certificate or report of short circuit type test	
15.	Rated operating duty cycle	
16.	Short circuit breaking current (a)Symmetrical (b)Symmetrical at rated voltage ©Asymmetrical at rated voltage (i)Per Phase (ii)Average (d)DC Component	
17.	Arcing time (At rated breaking current) in ms.	
18.	Opening time	
19.	Total break time in milli sec. (a)At 10% rated interrupting capacity (b)At rated interrupting capacity	
20.	Breaking Current (a)Rated out of phase current (b)Rated cable charging current (c)Rated kilometric fault level (d)Rated capacitor breaking current	
21.	Make time in ms.	
22.	Maximum temperature rise over ambient (a)Main contacts Terminals	
23.	Rated restriking voltage at 100% and 50%	

		rated capacity. (a)Amplitude factor (b)Phase factor ©Natural frequency (d)R.R.R.V.(Volts/micro sec.)	
24.		Dry 1 minute power frequency withstand test voltage (a)Between line terminal and earth KV RMS (b)Between terminals with breaker contacts open KV RMS.	
25.		1.2/50 full wave impulse withstand test voltage (a)Between line terminal and earth KVp. (b)Between terminals with breaker contacts open KVp.	
26.		SF6 /VCB interrupter make	
27.		Contact separation distance	
28.		Type of main contacts	
29.		Contact pressure	
30.		Contact resistance	
31.		Life of the interrupter (in number of operations)	
32.		(i)Tripping at rated current (ii)Tripping at maximum fault current. (Allowable maximum erotion 3 mm) (iii)Mechanical operations.	
33.		Details of main contacts making contact with the breaker truck with the panel	
34.		Control circuit voltage AC/DC.	
35.		Whether trip free or not	
36.		Whether all the interlocks provided	

ANNEXURE – 3
SCHEDULE OF GUARANTEED PARTICULARS FOR LOAD BREAK ISOLATORS & EARTHING ARRANGEMENTS

Sl.No.	Description	Isolators	Earthing switch for dt & isolator
01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's Design / Type ref/Model.		
03.	Material used for making the body of the isolators .		
04.	Standards of manufacturing		
05.	Whether the isolators & earth positions are manufactured as per IEC/IS standards		
06.	Maximum temperature with stand of the isolators & earth switches		
07.	1)Spacing between live part to Earth 2)Spacing between fixed and moving contacts in the open position.		
08.	Period of guarantee of the isolators		
09.	Rated frequency		
10.	Rated voltage		
11.	Highest system voltage		
12.	Rated current		
13.	Short time current rating with duration		
14.	Certificate or report of short circuit type test		
15.	Rated operating duty cycle		
16.	Short circuit breaking current		
17.	Arcing time (At rated breaking current) in ms.		
18.	Opening time		
19	Whether all the interlocks provided		
20	Fault passage indicator 1)Type/Model 2)Self powered Yes/No 3)Fault currents 4)Phase currents		

ANNEXURE – 4
SCHEDULE OF GUARANTEED PARTICULARS FOR CURRENT TRANSFORMERS

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design ref / model	
03.	Applicable Standards	
04.	1)Type of CT 2)Ratio	
05.	Rated Primary current	
06.	Rated secondary current	
07.	Rated frequency	
08.	Transformation ratio	
09.	Number of cores	
10.	Rated output (a) For Core-I	
11.	Class of insulation	
12.	Class of accuracy For Protection	
13.	Short time current rating and its duration	
14.	Secondary resistance at 70 Deg °C	
15.	Continuous over load (percentage)	
16.	One minute power frequency dry withstand voltage	
17.	1.2/50 micro sec. impulse withstand test voltage	
18.	One minute power frequency withstand test voltage on secondary	
19.	Instrument safety factor	
20.	Type of primary winding	
21.	Literature/leaflets pamphlets about the current transformer offered	
22.	Period of guarantee	

ANNEXURE – 5
SHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR SELF POWERED MICRO PROCESSOR BASED NUMERICAL RELAYS

01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's design / Ref. Type		
03.	Applicable Standards		
04.	CurrentSetting range for (a) Overcurrent relay	IDMT	
	(b) Earthfault Element	Definite Time	
05.	Whether the relay has the in-built facilities of IDMT, OL, EL		
06.	Details of IDMT Characteristics		
07.	Accuracy for different settings and limits of errors		
08.	Whether Alpha numeric / LED display		
09.	Whether compatible for 1 A CT Secondary		
10.	Whether draw out type		
11.	Types of case		
12.	Reset time		
13.	Burden of relay		
14.	Maximum and Minimum, operating ambient air temp.		
15.	Whether technical literature pamphlets about the relay offered.		
16.	Period of guarantee.		
17.	Certificate of Proof for Electro Magnetic Interference.		

General Technical Parameters

Sl. No.	Particulars	unit	HT UG Cable
1	Cables		
	a) Name of manufacturer		
	b) Place of manufacture		
2	Cable Type		A2XWY
3	Applicable specificaton & standards voltage Grade		IS: 7098 (Part-2) /11kV
4	Suitable for effective Earth/Unearth system		
6	Permissible voltage & frequency variation for satisfactory operation		
7	**Continuous current for standard conditon as per IS:**		
	a) In air (45° C)	Amps	
	b) In Ground (30° C)	Amps	
	c) In Duct	Amps	
8	**Conductor**		
	a) Material		Aluminium (H2/H4 Grade)
	b) Shape of conductor		Strandard compacted circular
	c) Geometrical cross sectional area	mm^2	
	d) Number of wire: (min)	No	
	e) Diameter of Wire : mm before compacting & strand Diameter	mm	
	f) Maximum DC resistance of the conductor at 20° C	Ω/KM	.....**(CR value only for reference)** Resistance test conductor to 5mtrs sample (Not in full drum length)
	g) Sampling batch for test		10% of ordered quantity
9	**Conductor Screening**		
	a) Material		Pressure Extruded Semiconducting compound
	b) Process		Triple Extrusion
	c) Thickness (Min)	mm	
	d) Continuous working temp	deg.C	90
	e) Max allowable temp at termination of short circuit	deg.C	250
10	**Insulation:**		
	a) Material		XLPE
	b) Thickness of Insulation (Nom)	mm	
	i) Between Cores	mm	
	ii) Between Cores & Inner Sheath		
	c) Minimum thickness of insulation at any one point	(mm)	
	d) Extrusion Type		Pressure Extruded
	e) Specific insulation resistance at 90° C	Ohm-cm	
	f)Process of Curing		
	g) Hot Set test:		
	a) Elongation under load	%	..... Max
	b) Maximum Permanent elongation after cooling	%	.....Max
	c) Tensile Strength at break	N/mm^2	..... Minimum
	d) Elongation at break	%	..... Min
11	**Insulation Screening:**		
	a) Material		Extruded Cross linked semi conducting compond
	b) Min. Thickness of extruded semi conducting layer	mm	
	c) Metallic Part: (Material)		Plain copper tape
	d) Size of copper Tape	mm	0.045
	e) Whether over lapping provided		Min 5% of Overlaping

	f) Short Circuit rating in 1 sec.	KA	
12	**Inner Sheath**		
	a) Material		PVC -ST2
	b) Extrusion Type		Pressure Extruded
	c) Thickness (Min)	mm	
	d) Nominal Dia over Inner Sheath	mm	
13	**Armouring**		
	a) Matcrial		Galvanised Steel
	b) Type of armouring		Round wire
	c) Nominal Dimensionof Armour wire	mm	..... Dimension and % of Tolerance
	d) Number of wires(not less than as per CSR 18-19)		..... Numbers
	e) Whether Galvanised		
	f) Mass of Zinc coating	gm/mm²	
	g) Nominal Dia over Armouring	mm	
	h) Short Circuit rating in 1 sec	KA	
14	**Outer Sheath**		
	a) Material		Extruded PVC Compound Type ST-2
	b) Extrution type		Extruded
	c) Min. thickness of sheath	mm	
	d) Nominal Overall diameter of cable	mm	
	e) Thermal stability test for sheath	Minutes	**100 minutes(Min)** Number of test specimen:6 Test results shall be within the range of ± 5% variation.
15	Short circuit withstand capacity		
	a) Short Circuit withstand capacity	KA	
	b) Duration of short circuit	sec	one
16	AC resistance per core at opcrating temperature	ohm/km	
17	Reactance Ohm/Km	ohm/km	
18	Capicitance per core	µF/Km	
19	Allowable maximum conductor temperature when carrying current		
20	Insulation resistance at 27° C	ohm-cm	
21	Loss tangent		
22	Maximum cable charging current at normal operating volt	A/km	
	Additional data		
23	Core identification		Application of coloured stripes Red, Yellow & Blue
24	Standard Packing Length and Tolerance	Mtrs	
25	Scheme of identification of the cable		manufacturer's name or trade mark, voltage grade, year of manufacture and the letters "**BESCOM OH-UG Cable Project**". The identification shall repeat every 300/350 mm along with length of the cable.

Guaranteed Technical Particulars of Rabbit ACSR Conductor		
Name of the bidder		
Sl. No.	**Particulars**	**Bidder**
1	Maker's Name, Address & Country	
	a) Aluminium rods	
	b) Steel wire/rods	
	c) Complete Conductor	
2	Stranding and Wire Diameter (mm)	
	a) Aluminium	
	b) Steel	
3	Nominal Aluminium area in Sq.mm.	
4	Sectional Area of Aluminium Strands in Sq.m.m.	
5	Total Sectional area in Sq.mm.	
6	Cross sectional area of nominal diameter wire in Sq.mm.	
	a) Aluminium wire	
	b) Steel Wire	
7	Overall diameter of conductor in mm.	
8	Breaking load of conductor in Kg.	
9	Minimum breaking load in Kg. for	
	a) Aluminium wire	
	b) Steel Wire	
10	Zinc coating of steel wire	
	a) Uniformity of coating No. and duration of dips (Process test with stood I min. X Nos.)	
	b) Minimum weight of coating (grm./Sq.mm.)	
11	Mass in Kg. per Km.	
	a) Aluminium wire	
	b) Steel Wire	
	c) Conductor	
12	Resistance in Ohms per Km. at 20 Deg.C.	
	a) Continuous maximum current rating of conductor (Amps) in still air or 45 Deg.C ambient temperature.	
	b) Temperature rise for the above current Deg. C.	
13	Purity of Aluminium Rods	
14	Maximum working tension for complete conductor Kg.	
15	Modulus of Elasticity (Kg/sq cm X 10^6)	
	a) Aluminium	
	b) Steel	
	c) Conductor	
16	Co-efficient of linear expansion per degree	
	a) Aluminium	
	b) Steel	
	c) Conductor	
17	Standard length of each piece in Km.	
18	Tolerance, if any on standard length	
19	No. of standard lengths in one reel	
20	Approximate dimensions of the reel in Cms.	
21	Mass of the conductor in one reel in Kg.	
22	Gross mass of the reel including mass of the conductor.	
23	Mass of the reel in Kg.	
24	Standard according to which the conductor will be manufactured and tested.	
25	Date of commencement of production of conductor.	
26	Other Particulars	

Technical Specification for 11 KV Class 400 Amps Double Break Group Operating Switches

1.0 **SCOPE:**

This specification covers the manufacture, testing at works and supply/erection of 11 KV Isolators of 400 Amps capacity, double break, complete with accessories such as operating pipe, connecting pipe, supporting insulators, link work, terminal connectors and locking arrangements as per IS 9921 of 1981 and to the owner's drawings.

2.0 The equipment offered shall confirm to IS 9921 of 1981 and latest amendments there off. The switches shall be suitable for horizontal upright mounting.

3.0 **CONSTRUCTION:**

3.1 The base shall be made of robust rolled M.S. Channel Section of size 75 x 40 mm. All ferrous parts shall be hot dip galvanized and all copper parts shall be tinned. The rotating shall be fitted with suitable bearings.

3.2 The blades and contacts shall be of best quality electrolytic copper and shall be capable of carrying rated current continuously without exceeding the temperature limits specified in Table 41 IS:9921 (part-II)

3.3 The insulators shall be of post type, brown glazed porcelain pedestal part type design E22 as per IS 5350 (Part III)/ 1971 with cap screws and spring washers and to technical specifications enclosed conforming to IS 2544 of 1973 with amendments thereof. The insulators baked in temperature controlled kilns only shall be used. The insulator used shall be as per relevant IS and BESCOM approved.

3.4 The operating pipe shall consist of Terminal pipe (spindle rod) of length 2450mm and vertical pipe of length 5400 mm. The pipes shall 25 mm diameter class 'B' (Medium Class). The G.I pipe used shall conform to IS 1239 part-1 1979 and amendments thereof. A guide to the vertical pipe of the operating pipe shall be provided to arrest its lateral movement. Necessary fixtures for fixing the guide to the pole shall also be supplied.

3.5 The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture of 400 Amps Double Break GOS along with relevant type test reports failing which, the offer will not be considered. The successful bidder should get the insulator make approved by BESCOM, before making supplies.

3.6 185sq mm Copper tinned Heavy duty long barrel lugs suitable for terminating Rabbit / Coyote ACSR conductor shall be provided for connecting conductor to the copper flats in the GOS.

3.7 All the Iron parts shall be hot dipped Galvanized and shall conform to the relevant IS specifications with latest amendments thereof.

3.8 **ARCING HORNS:**

The switches shall be supplied with hot dip galvanized arcing horns so that while opening/closing the G.O.S and arcing takes place between arcing horns not between the contacts.

3.9 **LOCKING ARRANGEMENTS:**

Suitable locking arrangement shall be provided for arresting the operating handle.

4.0 **CHARACTERISTICS:**

a) System voltage – 11 KV
b) Rated Voltage – 12 KV
c) Rated Insulation Level:
   1. To earth and between poles 75 KV (Peak)
   2. Across Isolating Distance 85 KV
d) Rated one minute power frequency withstand test Voltage
   1. To earth and between poles 28 KV
   2. Across Isolating distance 85 KV
e) Rated normal current – 400 Amps
f) Rated duration of short circuit – 3 Secs.
g) Rated short time withstand current – 10 KA
h) Type of break – horizontal, double break.

5.0 **TYPE TEST CERTIFICATE:**

The following shall constitute type tests.

a) Impulse voltage dry test
b) Power frequency voltage dry test.
c) Power frequency voltage wet test
d) Temperature rise test
e) Measurement of Resistance
f) Test for rated peak short circuit current
g) Operation tests
h) Mechanical endurance tests.

6.0 **ROUTINE TESTS:**

The routine tests as per IS 9921 shall be conducted on each G.O.S

7.0 **NAME PLATE:**

The group operating switch shall be provided with the name plate legibly and indelibly marked with the following information:

1. Name of materials
2. Name of the manufacturer/Trade Mark
3. Name of the Purchaser that is the letters (BESCOM)
4. Purchase order No. and Date
5. Type-designation and Sl. No
6. Rated Voltage
7. Rated Current
8. IS Specification

TECHNICAL SPECIFICATION FOR 11KV PEDESTAL POST INSULATORS

1.0 **General Requirements**: The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture GOS along with relevant type test reports failing which, the offer will not be considered. The successful bidder should get the insulator make approved by BESCOM, before making supplies.

2.0 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed, the glaze on insulators shall be brown in colour and should cover all exposed porcelain parts except those areas which serve as supports during fixing are required to be left unglazed as detailed in IS:2544-1963.

3.0 Precaution shall be taken during design and manufacture to avoid the following:

a) Stress due to expansion and contraction which may lead to deterioration.

b) Stress concentration due to direct engagement of the porcelain with the metal fittings.

c) Retention of water in recesses of metal fittings and shape which do not facilitate easy cleaning by normal methods.

4.0 All metal parts except those of stainless steel shall be hot dip galvanized after machining zinc coating shall satisfy the requirement of relevant IS specification. The finished galvanized surface shall be smooth.

5.0 The threads of the tapped holes on the post insulator metal fittings shall be cut after galvanizing and shall be protected against rust by greasing or other similar means. All other threads shall be cut before galvanizing.

6.0 The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fitting shall be in vertical plane containing the axis of the insulator.

7.0 **Technical Particulars**:

Individual Units : 11kV stacking units.

1) Rating : 11kV

2) a) Unit description (as per ISS:5350/Part-III/1971) : E-22 (Except torsion strength as specified)

b) Mechanical strength as per Clause 3.2 of IS:5350/ Prt-III/1971. : Strength class 'C' 7.5 to 12KN

3) Highest system voltage : 12 kV (rms)

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4) Impulse withstand voltage : 75 KV (peak)

5) One minute Power frequency withstand Voltage
Dry : 55 kV (rms)
Wet : 35 kV (rms)

6) Power Frequency Puncture withstand voltage (rms) : 1.3 times the actual dry flash cover voltage of the unit.

7) Visible Discharge test voltage : 9 KV (rms)

8) Creepage distance : 230 mm

9) Failing load (as per IS:5350 Part-III/1971)
(a) to (d) in Newtons and
(e) in Newton meters

a) Upright : 9000 N
b) Underhung : 4500 N
c) Tension : 20000 N
d) Compression : 40000 N
e) Torsion : 680 Nm

10) Height of insulator (Min) : 254mm (Tolerance ±1mm)

11) Insulating part dia (Max) : 152 mm

12) Top metal fitting pitch circle dia : 57 mm

13) Bottom metal fitting pitch circle dia: 57 mm

14) a) No. of bolts : 4 Nos.
b) Bolts holes dia : 10 mm tapped holes at the top and 12 mm plain holes at the bottom.
c) Nominal dia of mounting face not to exceed : 85 mm

8.0 **Marking**: Each insulator shall be legibly and indelibly marked with the following.
a) Name or trade mark of the manufacture
b) Month and year of manufacture
c) ISI certificate mark if any
Marking shall be durable and shall be printed by the transfer process before firing.

NOTE: Manufacturer's Test Certificate and type test certificate conducted on similar sample insulator shall be submitted for approval before commencement of supplies.

9.0 **BOM**: Bill of Materials as per Drawing.

GUARANTEED TECHNICAL PARTICULARS FOR 11 KV 400 AMPS DOUBLE BREAK GOS

Sl. No.	Details	Results
I	Material	
1	Name of the manufacturer	
2	Type	
3	No. of poles	
4	Frequency	
5	Voltage Rating	
6	Current Rating in Amps a) Normal b) Maximum	
7	Temperature rise of the following at full rated current in O.C over ambient temperature	
8	Whcthcr contacts are silver coated or tin coated along with thickness of coating in mm.	
9	Voltage drop across terminals of poles	
10	Short time current and duration	
11	Material of fixed contact	
12	Material of moving blade	
13	Material of terminal connector	
14	Type Diameter and length of operating handle	
15	Materials of arcing horns	
16	Size and length of base mounting channel	
17	Whether the Air break switch is complete with all accessories	
18	Whcthcr Dimcnsional drawing is enclosed with the tender	
19	Minimum clearance between phase (The center distance between the insulators of adjacent phase in the assembled position of switch)	
20	Center to center distance between insulators of the consecutive poles of the samc phasc in the assembled position of switch (in mm)	
21	Whether mechanical interlock has been provided for arcing switches	
22	Type of bearings use in: 1. Rotating insulator stack. 2. To earth and between poles	
23	Impulse withstand voltage with 1/50 M.S wave positive and negative polarity.	
24	One minute power frequency withstand voltage across isolating distance3 to earth and between poles.	
II	**PARTICULARS OF INSULATORS**	
1	Type of insulators	
2	Name of manufacturer of insulators	
3	Height of the insulators	
4	Diameter of the largest shell	
5	Number of uni9ts per stack	
III	**ELECTRICAL CHARACTERISTICS**	

1	Flash over voltage	
2	Dry power frequency	
3	Wet power frequency	
4	Impulse voltage of 1/50 micro-sec(+ve)	
5	Impulse voltage of 1/5-micro-sec(-ve)	
6	Power frequency puncture withstand voltage of unit	
IV	Mechanical characteristics:	
	a. Cantilever strength under upright b. Cantilever strength under torsional c. Torsional strength d. Tensile Strength	
V	General Characteristics a) Minimum Creepage conforms b) Weight of complete unit	
VI	Standard to which insulator conforms	
VII	Number of Insulators per set	

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TECHNICAL SPECIFICATION FOR 11KV 200AMPS SINGLE BREAK GROUP OPERATION SWITCHES

1.0 **Scope**: This specification covers the manufacture, testing at manufacturer's works and supply of 11KV Group operating switches of single break 200 Amps. Capacity complete with accessories, such as operating pipe, connecting pipe guides, supporting insulators, link work and locking arrangement, etc., complete conforming to IS-9921(Part 1 to 5) and the enclosed typical drawings.

2.0 **Weather Conditions**: The switches are to be installed at places with the following weather conditions.

Temperature	: Maximum ambient	- 45°C
Daily average	: Average	- 35°C
	: Minimum	- 5°C
	: Altitude	- Not to exceed 1000 Mtrs. above sea level

3.0 The equipment offered shall conform to IS–9921 and latest amendments thereof. The switches shall be suitable for horizontal upright mounting.

4.0 **Construction**:

4.1 The base shall be made of robust rolled M.S. channel section of size 75 x 40x6 mm. All ferrous parts shall be hot dip galvanized and all copper parts shall be tinned. The rotating parts shall be fitted with suitable bearing.

4.2 The blades and contacts shall be made of best quality electrolytic copper and shall be capable of carrying the rated current without exceeding the temperature limits specified in table-4 of IS-9921 (part-II).

4.3 The insulators shall be of post type, brown glazed porcelain pedestal post type design E.22 as per ISS:5350 (Part-III)/1971 with cap screws and spring washers and to technical specification enclosed conforming to IS:2544-1973 with amendments thereof.

4.4 The operating pipe shall consist of Tandem pipe (spindle rod) of length 2000 mm and the vertical pipe of length 5400 mm. The pipe shall be seamless 25mm diameter "B" type class (i.e., medium class) G.I. Pipe. The G.I. Pipe used shall conform to IS-1239-Part-I-1979 and amendments thereof. A guide shall be provided to the vertical operating pipe an intermediate position to arrest its lateral movement. Necessary fixing arrangements of the guide to the pole should also be supplied.

4.5 The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture of 200 Amps Single Break GOS along with relevant type test reports failing which, the offer will not be considered. The successful bidder should get the insulator make approved by BESCOM, before making supplies.

4.6 95 Sqmm heavy duty long barrel tinned copper lugs-6 Nos., suitable for terminating Weasel/Rabbit ACSR Conductor shall be provided for connecting conductor to the copper flats in the GOS.

4.7 All the iron parts shall be hot dip galvanized and shall conform to the relevant IS specifications with latest amendments those of.

4.8 **Arcing Horns**: The switches shall be supplied with hot dip galvanized arcing horns so that while closing or opening the switches, arcing takes place between the arcing horns and not between the main contacts.

4.9 **Locking Arrangements**: Suitable locking arrangements shall be provided for the operating handle.

4.10 The switches shall be designed to withstand the test voltage as per IS: 9921 or its latest revision thereof. The switches shall be designed to have the following current ratings.

Continuous current carrying capacity	
Without over heating	: 200A
Short Time Current for 1Second rating	: 8 kA
Rated peak dynamic withstand current	: 20kA

5.0 **Test and Test Certificate**:

5.1 **Routine Tests**: The Routine test as per IS:9921 shall be conducted on each G.O.S in the presence of BESCOM representative and certificate shall be submitted duly signed by a responsible officer of the tenderers/organization before dispatch of consignment.

5.2 BESCOM reserves the right to get the type test conducted as per IS:9921 on a selected G.O.S in the presence of BESCOM's testing staff at the cost of the supplier.

1) Impulse Voltage dry test
2) Power frequency voltage dry test
3) Power frequency voltage wet test
4) Temperature rise test
5) Measurement of resistance
6) Test for rated peak short circuit current
7) Operation test
8) Mechanical endurance test

5.3 **Packing**: The group operating switches shall be securely packed to withstand rough handling during the transit and storage.

5.4 **Name Plate**: The group operating switch shall be provided with the name plate legibly and indelibly marked with the following information:

1) Name of materials
2) Name of the manufacturer/Trade mark
3) Letters (BESCOM)
4) Purchase order No. and Date
5) Type-designation and Sl. No.
6) Rated voltage
7) Rated current
8) IS specification

TECHNICAL SPECIFICATION FOR 11KV PEDESTAL POST INSULATORS

1.0 **General Requirements**: The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture GOS along with relevant type test reports failing which, the offer will not be considered. The successful bidder should get the insulator make approved by BESCOM, before making supplies.

2.0 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed, the glaze on insulators shall be brown in colour and should cover all exposed porcelain parts except those areas which serve as supports during fixing are required to be left unglazed as detailed in IS:2544-1963.

3.0 Precaution shall be taken during design and manufacture to avoid the following:

a) Stress due to expansion and contraction which may lead to deterioration.

b) Stress concentration due to direct engagement of the porcelain with the metal fittings.

c) Retention of water in recesses of metal fittings and shape which do not facilitate easy cleaning by normal methods.

4.0 All metal parts except those of stainless steel shall be hot dip galvanized after machining zinc coating shall satisfy the requirement of relevant IS specification. The finished galvanized surface shall be smooth.

5.0 The threads of the tapped holes on the post insulator metal fittings shall be cut after galvanizing and shall be protected against rust by greasing or other similar means. All other threads shall be cut before galvanizing.

6.0 The post insulator unit shall be assembled in a suitable jig to ensure

the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fitting shall be in vertical plane containing the axis of the insulator.

7.0 **Technical Particulars**:

Individual Units	: 11kV stacking units.
1) Rating	: 11kV
2) a) Unit description (as per ISS:5350/Part-III/1971)	: E-22 (Except torsion strength : as specified)
b) Mechanical strength as per Clause 3.2 of IS:5350/ Prt-III/1971.	: Strength class 'C' 7.5 to 12KN
3) Highest system voltage	: 12 kV (rms)
4) Impulse withstand voltage	: 75 KV (peak)
5) One minute Power frequency withstand Voltage	
Dry	: 35 kV (rms)
Wet	: 35 kV (rms)
6) Power Frequency Puncture withstand voltage (rms)	: 1.3 times the actual dry flash cover voltage of the unit.
7) Visible Discharge test voltage	: 9 KV (rms)
8) Creepage distance	: 230 mm
9) Failing load (as per IS:5350 Part-III/1971) (a) to (d) in Newtons and (e) in Newton meters	
a) Upright	: 9000 N
b) Under hung	: 4500 N
c) Tension	: 20000 N
d) Compression	: 40000 N
e) Torsion	: 680 Nm
10) Height of insulator (Min)	: 254mm (Tolerance ±1mm)
11) Insulating part dia (Max)	: 152 mm
12) Top metal fitting pitch circle dia	: 57 mm
13) Bottom metal fitting pitch circle dia	: 57 mm

14) a) No. of bolts : 4 Nos.
b) Bolts holes dia : 10 mm tapped holes at the top and 12 mm plain holes at the bottom.
c) Nominal dia of mounting face not to exceed : 85 mm

8.0 **Marking**: Each insulator shall be legibly and indelibly marked with the following.
a) Name or trade mark of the manufacture
b) Month and year of manufacture
c) ISI certificate mark if any
Marking shall be durable and shall be printed by the transfer process before firing.

NOTE: Manufacturer's Test Certificate and type test certificate conducted on similar sample insulator shall be submitted for approval before commencement of supplies.

9.0 **Marking :** Bill of Materials as per Drawing.

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GUARANTEED TECHNICAL PARTICULARS FOR 11 KV 200 AMPS SINGLE BREAK GOS

Sl. No.	Details	Results
I	Material	
1	Name of the manufacturer	
2	Type	
3	No. of poles	
4	Frequency	
5	Voltage Rating	
6	Current Rating in Amps a) Normal b) Maximum	
7	Temperature rise of the following at full rated current in O.C over ambient temperature	
8	Whether contacts are silver coated or tin coated along with thickness of coating in mm.	
9	Voltage drop across terminals of poles	
10	Short time current and duration	
11	Material of fixed contact	
12	Material of moving blade	
13	Material of terminal connector	
14	Type Diameter and length of operating handle	
15	Materials of acring horns	
16	Size and length of base mounting channel	
17	Whether the Air break switch is complete with all accessories	
18	Whether Dimensional drawing is enclosed with the tender	
19	Minimum clearance between phase (The center distance between the insulators of adjacent phase in the assembled position of switch)	
20	Center to center distance between insulators of the consecutive poles of the same phase in the assembled position of switch (in mm)	
21	Whether mechanical interlock has been provided for arcing switches	
22	Type of bearings use in: 1. Rotating insulator stack. 2. To earth and between poles	
23	Impulse withstand voltage with 1/50 M.S wave positive and negative polarity.	
24	One minute power frequency withstand voltage across isolating distance3 to earth and between poles.	
II	**PARTICULARS OF INSULATORS**	
1	Type of insulators	
2	Name of manufacturer of insulators	
3	Height of the insulators	
4	Diameter of the largest shell	
5	Number of uni9ts per stack	

III	**ELECTRICAL CHARACTERISTICS**	
1	Flash over voltage	
2	Dry power frequency	
3	Wet power frequency	
4	Impulse voltage of 1/50 micro-sec(+ve)	
5	Impulse voltage of 1/5-micro-sec(-ve)	
6	Power frequency puncture withstand voltage of unit	
IV	Mechanical characteristics:	
	a. Cantilever strength under upright b. Cantilever strength under torsional c. Torsional strength d. Tensile Strength	
V	General Characteristics a) Minimum Creepage conforms b) Weight of complete unit	
VI	Standard to which insulator conforms	
VII	Number of Insulators per set	

(S1)

Section: Technical Specifications

DAS Ring Main Units

1 Introduction

This document contains the Technical Specifications that apply to DAS Ring Main Units of 3-Way, 4-Way and 5-Way configurations, which covers the supply of Ring Main Units (RMUs) within the BESCOM.

1.1 Key RMU Components

Key RMU components are listed as follows:

- Two (2) load break switches (LBSs) with earthing switches, also known as Operating Devices (ODs), connecting the RMU to incoming and outgoing main loop, 11 kV, 630 Amp capacity capable to connect XLPE cables of size 240/400 mm^2 cross section.
- One (1) to three (3) circuit breakers (CBs) with earthing switches, also known as Vertical Lines (VLs), connecting the RMU to distribution loop, 11 kV, 400 Amp capacity capable to connect XLPE cables of size 95/240 mm^2 cross section.
- One (1) to three (3) numerical relays for overcurrent (OC) and earth fault (EF) protection in conjunction with the corresponding circuit breaker(s).
- One (1) Fault Passage Indicator (FPI) in the RMU's main loop circuit to provide indications that feeder downstream phase or earth faults have occurred.
- All necessary voltage and current sensors for metering and protection.
- All necessary dry (potential-free) contacts for indications relevant to RMU monitoring and control.
- Two (2) multifunction meters serving as Intelligent Electronic Devices (IEDs) to provide voltage, current, power, energy and power factor readings that correspond to the RMU's main-line circuits.
- A power supply unit, including auxiliary power transformer and battery backup, to provide stable 24 V DC and 12 V DC sources of power for a separately supplied RTU and radio respectively as well as necessary sources of power for the RMU's spring-charge motors, FPI, relays, and multifunction meters. The power supply shall also provide for RMU enclosure lighting fixtures and power-plug receptacles for maintenance/test equipment.
- Capacitor voltage dividers serving live-line cable indicators.

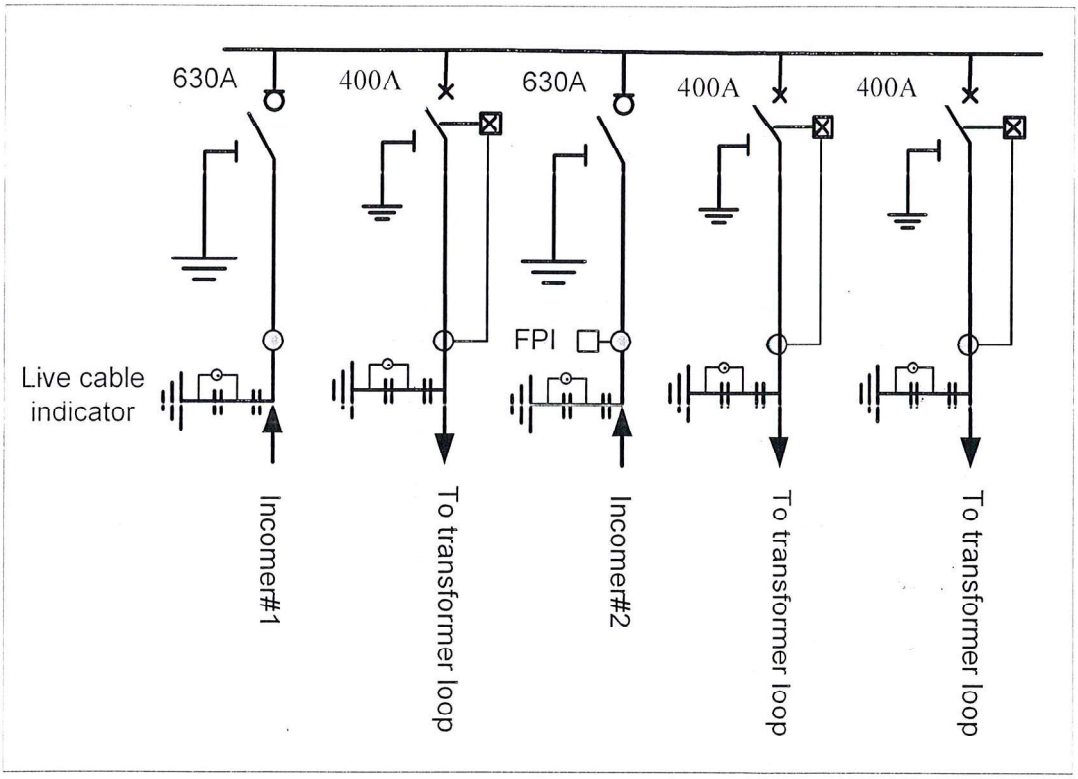
A typical five-way RMU configuration is illustrated in Figure 1-1. In this case, the RMU has six enclosures, one for each of the two load break switches, one for each of the three circuit breakers or VLs, and one for the RMU's auxiliary power supply unit and the necessary SCADA monitoring and

control equipment. The SCADA monitoring and control equipment includes the RTU and radio as supplied by others and referenced elsewhere in these specifications.

1.2 Ring Main Units

Each RMU shall include its own power supply unit (including auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for not only the RMU, but also the RTU and radio that the RMU must be capable of housing.

Figure 1-1: Typical RMU Configuration



Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral circuits, it shall be equipped with a corresponding set of circuit breakers and numerical relays. The RMU interrupters of reputed make shall be enclosed in an SF_6 or vacuum medium and the RMU will include all necessary voltage and current sensors and potential-free contacts so that, as a minimum, the DAS via its RMU remote interface can:

- Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
- Monitor the local/remote position of RMU manually-operated switches that can be used to enable and disable remote monitoring and control of individual ODs and VLs.

- Monitor the health of the power supply, which will include battery failure and low voltage indications.
- Monitor the open/closed status of RMU earthing switches.
- Monitor the open/closed status of RMU enclosure doors.
- Monitor for low SF_6 gas pressure readings.
- Monitor circuit breaker and load break switch spring charge (switch readiness) status.
- Monitor for circuit breaker relay operations.
- Monitor for main-circuit fault currents detected by the RMU's FPI.
- Monitor the number of operations of the RMU's circuit breakers and load break switches.
- Monitor voltage, current, power, energy, and power factor values corresponding to the RMU's main circuits and the phase currents corresponding to the RMU's lateral circuits.

1.3 Specification Organization

These Technical Specifications for DAS RMUs are organized as follows:

- **Clause 1: RMU Design Features.** This clause includes design features related to RMU availability, maintainability, expandability, life span and relevant physical and electrical properties.
- **Clause 2: RMU Characteristics.** This clause describes the main characteristics that relate to the functional and design aspects of RMU components such as line sensors, FPIs, protection relays, multi-function meters, motors, auxiliary transformers, power supply equipment, and enclosures.
- **Clause 3: Inspection and Test.** This clause includes requirements related to inspections, test procedures, test records, factory acceptance tests, site acceptance tests, and commissioning.

1.4 Applicable Standards

The RMUs shall be manufactured to the highest quality consistent with best practice and workmanship and in full accord with the Contractor's quality assurance plan. The RMUs and the work associated with their installation shall also conform to the Indian and equivalent international standards that are applicable. These include the standards listed in Table 1-1 below.

The Contractor shall provide an English language copy of the applicable Indian and equivalent international standards met by the proposed RMU.

1.5 Environmental Conditions

All materials supplied shall be capable of operating without fault in a tropical climate, which exhibits a high level of ultra-violet radiation and severe thunderstorms. Relevant environmental conditions are listed as follows:

- Maximum ambient air temperature: 45 °C
- Minimum ambient air temperature: 10 °C
- Maximum relative humidity: 90 %
- Average thunder storm days per annum: 50
- Average rainfall per annum: 900 mm
- Maximum wind speed: 119 km/hr
- Altitude above mean sea level: 1000 m

1.6 Distribution Network Electrical Parameters

The main parameters of the BMAZ distribution network are as follows:

- Nominal system voltage: 11 kV (rms)
- Highest system voltage: 12 kV (rms)
- Number of phases: 3
- Frequency: 50 Hz
- Variation in frequency: 49 Hz to 50.5 Hz
- Type of earthing: Solid
- Power frequency withstand voltage: 28 kV
- Basic impulse withstand voltage: 75 kV

Table 1-1: Applicable Standards

Standard	Description
IS 3427	AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS 9920 (Parts 1 to 4)	High Voltage Switches
IS 9921 (Parts 1 to 5)	Specification for AC disconnectors and earthing switches for voltages above 1000 V
IS 13118	HV AC Circuit Breakers
IS 10601	Dimensions of terminals of HV Switchgear and Control gear
IS 12729	General requirements of switchgear and control gear for voltages exceeding 1000 V
IEC 1330	High voltage/Low voltage prefabricated substations

Standard	Description
IEC 60694	Common clauses for MV switchgear standards
IEC 6081	Monitoring and control
IS 2705	Current Transformers
IS 3156	Voltage transformers
IS 8686	Specification for Static Protective Relays
IEC 62271-200	Standards for high voltage metal clad switchgear up to 52 KV.

1.7 Testing

The specified RMUs shall be subject to type tests, routine tests, and acceptance tests. Where applicable, these tests shall be carried out as per the standards stated above. Prior to testing, the Contractor shall prepare and submit a detailed test plan for review and approval by the Employer.

2 RMU Design Features

All design features of the proposed DAS RMU, shall be fully supported by the equipment actually delivered. The key design features include those that relate to:

- Availability, maintainability, expandability, and life span
- Ability to operate in severe outdoor environmental conditions
- Immunity to electrical stress and disturbance
- Acceptable insulation properties
- Acceptable surge suppression characteristics
- Convenient RTU interconnection features

In these and all other specified respects, the RMU shall meet or exceed the cited standards or, where appropriate, other equivalent industry standards.

2.1 Availability, Maintainability, Expandability, and Life Span

2.1.1 Availability

The RMU shall be designed to have a fully enclosed metal housing combined with the single-phase insulation of all primary live parts to reduce the risk of internal faults to an absolute minimum and to provide a high degree of safety as well as availability. Nevertheless, manufacturer standard designs shall be used to the fullest extent possible.

Each RMU shall exhibit an availability of greater than 99.5%. To ensure this high degree of availability, the RMUs shall be fabricated, assembled, and finished with workmanship of the highest production quality and shall conform to all applicable quality control standards. All materials comprising the RMU shall be new, unused, and of the best industrial grade, and the RMU shall incorporate all recent improvements in both design and materials. All components shall be of current production from reliable component manufacturers.

2.1.2 Maintainability

The Employer intends to be self-reliant for RMU maintenance. To this end, the Contractor shall provide the support, documentation, and training necessary to operate and repair the RMU. This shall include, but shall not be limited to the maintenance manuals and repair kits applicable to the Contractor's RMU design. Details of the proposed repair kits shall be provided with the bid documents.

The Employer prefers RMU designs that do not require periodic preventive maintenance and inspections.

To facilitate expansion and maintenance, modularity shall be employed in the design of the equipment. All major subassemblies shall carry permanent labels providing a cross-reference to the Contractor's corresponding documentation.

2.1.3 Expandability

The RMUs shall be designed such that, in the future, they can be expanded to accommodate additional enclosures containing circuit breakers and associated equipment that will allow the RMU to supply power to additional distribution circuits. In this respect, for example, the 3-way RMU shall be expandable in the field to a 5-way RMU.

2.1.4 Life Span

Each RMU shall have a design life of at least 20 years from the date of final acceptance. The Contractor shall make available, at no cost to the Employer, the manufacturing designs, drawings, and the rights to manufacture any subassemblies that the manufacturer will not support or discontinues to support during this life span. The specific components of each sub-assembly shall be identified and referenced in Contractor-supplied documentation.

2.2 Outdoor Features

2.2.1 General

The RMUs shall be designed specifically for outdoor installation and, in this respect, shall be suitable for continuous operation in a tropical climate that includes exposure to severe frequently occurring thunderstorms. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, salt-spray, and high levels of airborne dust.

The equipment in the proposed outdoor RMU shall be conformably coated to meet these climatic conditions. In this respect, standards such as IEC 60870-2-2 covering equipment, systems, operating conditions, and environmental conditions shall apply along with IEC 60721, which covers the classification of such conditions. In particular, the RMU equipment shall have been type tested for continuous operation under the environmental conditions.

In addition to the above, materials promoting the growth of fungus or susceptibility to corrosion and heat degradation shall not be used, and **steps shall be taken to provide rodent proof installations.**

2.2.2 Corrosion Protection

Except for stainless steel, all steel surfaces that are not galvanized shall be treated to protect against corrosion. As a minimum, corrosion treatment shall include the following procedures:

- The surface shall be cleaned to bare material by mechanical or chemical means.
- One or more phosphatizing or priming coats of paint shall be applied to the bare surface using a zinc-based or lead-based primer.
- A finish coat with high scratch resistance or epoxy powder finish paint shall be applied over the primer. The coat thickness shall be of the order of 50 to 70 micrometers. The Employer shall approve the finish-coat color. The RAL-code will be agreed upon with the Contractor during the early design phases of project implementation.

2.2.3 Galvanizing

Except for stainless steel, and unless otherwise stated, all structural steel and all exterior and interior steel surfaces of the RMUs, as well as nuts and bolts associated with galvanized parts, shall be hot-dipped galvanized in accordance with IS 802 or an equivalent international standard.

2.3 Immunity to Electrical Stress and Disturbance

The electrical and electronic components of the DAS RMU shall conform to relevant standards concerning insulation, isolation, and immunity from electromagnetic interference, radiated disturbance, and electrostatic discharge. The ability to meet these requirements shall be verified by type tests carried out by accredited test laboratories that are independent of the bidder and/or the manufacturer of the RMU components. Certified copies of all available type test certificates and test results shall be included as part of the bidder's proposal. Failure to conform to this requirement shall constitute grounds for rejection of the proposal.

2.4 Minimum Insulation of Equipment

The RMUs shall be of SF_6 gas-insulated type. Otherwise, from an insulation perspective, the DAS RMU shall be designed so as to minimize exposure to electrically live terminals when visual inspection or maintenance of the internal components is being conducted.

2.5 Surge Voltage Suppression

The DAS RMU equipment shall be designed to operate on input power containing voltage spikes. Equipment shall be protected against part failure or malfunction such as intermittent firing of triggering devices due to surge voltage spikes occurring randomly over the instantaneous supply voltage.

2.6 Nameplate Information

RMU nameplate information shall be determined in agreement with the Employer. This information may include for example:

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current
- Rated frequency
- Rated symmetrical breaking capacity
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage
- Purchase Order number and date
- Month and year of supply

Each DAS RMU shall also exhibit a Danger Board to indicate the presence of high voltage (11000V).

2.7 Interconnecting Cables, Wiring, Connectors, and Terminal Blocks

The Contractor shall provide all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required by the RMU.

2.7.1 Metallic Cables

All metallic cables and wiring shall be of required cross-section solid or multiple strands of round copper conductors and have flame retardant insulation. All wiring shall be neatly laced and clamped.

All wire and cable connectors and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily accessible for connection and disconnection and shall be permanently labeled. Conductors in multi-conductor cables shall be individually color-coded.

2.7.2 Connectors

Plug-type connectors with captive fasteners shall be used for all interconnections. The connectors shall be polarized to prevent improper assembly.

2.7.3 RMU-RTU Connectors

For ease of installation and maintenance, the interconnection between the RMU and the RTU, i.e., the RTU to be installed by others in a separate RMU enclosure, shall be supported by having a multi-pin connector installed in each and every DAS RMU enclosure.

To accommodate all of the DAS RMU equipment points to be monitored and controlled, the connector installed in the enclosure (the Control Cabinet) containing the RTU shall in all cases be sized to accommodate a 5-way RMU, e.g., whether the RMU is 3-way or 5-way, the connector for interconnecting the RMU and RTU shall consist of six (6) multi-pin connectors as illustrated in Figure 2-1.

The following concepts shall apply:

- The Control Cabinet's fixed connector shall consist of 6 individual multi-pin connectors having 24 female inserts and contacts capable of being wired to the RTU and to single multi-pin connectors of female type fixed within the other RMU enclosures via separate hooded plugs having 24 male inserts and contacts attached to cables of suitable length. The RTU male connector and its cable will be provided by the RTU contractor.
- All cabling for the RMU's analog and status input points, control output points, and auxiliary contacts shall be brought out to the single multi-pin connectors in the RMU enclosures. Modbus communication cable shall be adequate size (Minimum 1.5 sqmm) with outer sheath screen cable
- Wiring between the single female connectors in the OD and VL enclosures and the female connectors in the Control Cabinet shall take the form of Contractor-provided cables having at both ends a corresponding male connector.

- The female multi-pin connectors shall contain a locking lever so that, in combination with the male connectors, they shall act as a mechanical locking device between male and female connector pairs. The lever shall only be fully locked if the two connectors are mated correctly.

2.7.4 Terminal Blocks

Apart from the connectors described above Clause, heavy-duty terminal blocks with screw type terminals for 5 mm minimum machine screws shall be provided by the Contractor for other necessary metallic cable terminations. Terminals for auxiliary relays shall equal or exceed the relay wiring requirements. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals.

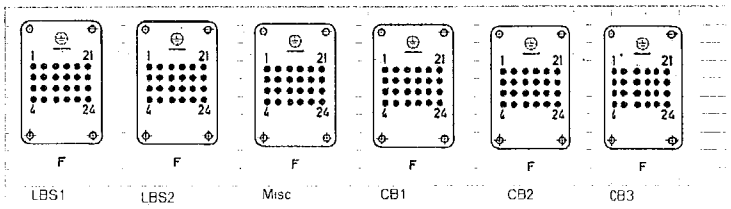
Self-extinguishing fireproof vinyl marking strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally. All terminals to which battery or other high voltages are connected shall be provided with fireproof covers.

All individual status input, AC voltage input, and control output points shall be isolatable without the need to remove wiring by means of individual terminal blocks of the removable link type. In order to avoid open circuits on the secondary side of CTs, termination blocks with by-pass bridges shall be provided for all AC current inputs.

Terminal blocks shall comply with IEC 60947-7-1 (2009): Low-voltage Switchgear and Control Gear, Part 7-1: Ancillary Equipment, Terminal Blocks for Copper Conductors.

Figure 2-1: RMU/RTU Connector Pin-Out

Pin nrs		LBS 1	Pin nrs		LBS 2	Pin nrs		Miscellaneous	Pin nrs		CB1	Pin nrs		CB2	Pin nrs		CB3
1	2	LBS 1: closed	1	2	LBS 2: closed	1	2	SF_6 Pressure: low	1	2	CB 1: closed	1	2	CB 2 closed	1	2	CB 3: closed
3	4	LBS 1 open	3	4	LBS 2: open	3	4	Charger AC: fail	3	4	CB 1: open	3	4	CB 2 open	3	4	CB 3: open
5	6	Spring 1: charged	5	6	Spring 2: charged	5	6	Voltage DC: low	5	6	Spring 1: charged	5	6	Spring 2: charged	5	6	Spring 3: charged
7	8	Earth switch 1: closed	7	8	Earth switch 2: closed	7	8	Battery alarms: Battery-failed, etc.	7	8	Earth switch 1: closed	7	8	Earth switch 2: closed	7	8	Earth switch 3: closed
9	10	Earth switch 1: open	9	10	Earth switch 2: open	9	10	Spare	9	10	Earth switch 1: open	9	10	Earth switch 2: open	9	10	Earth switch 3: open
11	12	Spare	11	12	FPI: overcurrent operated	11	12	Spare	11	12	Overcurrent relay 1: operated	11	12	Overcurrent relay 2: operated	11	12	Overcurrent relay 3: operated
13	14	Spare	13	14	FPI: earth fault operated	13	14	Spare	13	14	Earth fault relay 1: operated	13	14	Earth fault relay 2: operated	13	14	Earth fault relay 3: operated
15	16	LBS1: Local/Remote Status	15	16	LBS2: Local/Remote Status	15	16	Spare	15	16	CB1: Local/Remote Status	15	16	CB2: Local/Remote Status	15	16	CB3: Local/Remote Status
17	18	LBS 1 control: close	17	18	LBS 2 control: close	17	18	Spare	17	18	CB 1 control: close	17	18	CB 2 control: close	17	18	CB 3 control: close
19	20	LBS 1 control open	19	20	LBS 2 control open	19	20	Spare	19	20	CB 1 control: open	19	20	CB 2 control: open	19	20	CB 3 control: open
21	22	Door: open	21	22	Door: open	21	22	Spare	21	22	Door: open	21	22	Door: open	21	22	Door: open
23	24	Spare	23	24	FPI: reset	23	24	Spare	23	24	Spare	23	24	Spare	23	24	Spare



3 RMU Characteristics

As a minimum, the RMUs shall be equipped with main-line load break switches and a fault passage indicator (FPI), circuit breakers, and numerical relays for the protection of laterals, and multifunction meters providing voltage, current, power, energy, and power factor readings. The Load Break Switches and the Circuit Breakers used in the RMU shall be of SF_6 insulated and vacuum interrupter type.

In addition, each RMU shall be equipped with all necessary connectors, terminal blocks, and other accessories that will allow the RTU it will house to send required RMU/distribution network indications and measurements to the DAS via the communications system.

3.1 General Requirements

Each RMU shall include its own power supply, including battery and battery charger, and provisions for supplying a stable source of power for the RTU and radio to be housed by the RMU. Thus, the RMU shall also provide the necessary space for housing the RTU and radio. In addition, space must be provided for the RMU's auxiliary power transformer, which shall serve as the power supply's 230 V AC input, along with all other RMU devices such as the PTs and CTs for deriving voltage and current signals.

Within this context, the general requirements of the RMU shall include, but shall not be limited to provision of the following monitoring and control features:

- Positions of local/remote switches as used to control local and remote access to circuit breakers and load break switches
- Power supply indications including battery failure and voltage alarms
- Open/closed position of load break switches, circuit breakers, and earthing switches
- Enclosure door-open indications
- SF_6 gas-pressure low alarm
- Circuit breaker and load break switch spring charge (switch readiness) indications
- Circuit breaker relay indications
- Indications of fault current in the RMU's main feeder circuit as detected by the FPI
- Measurement of 11 kV voltage, current, power, energy, and power factor values
- Load break switch and circuit breaker open/close control
- FPI reset control
- Relay settings control

Commissioning of the RMUs shall not be complete until they have been demonstrated on a point-to-point basis to be fully interoperable with the DAS.

3.2 Parameter Requirements

The RMUs shall be suitable for main cable networks of 630 Amps and loop cable networks of 400 Amps. The minimum design parameters to which their major components shall conform or exceed are summarized in the following tables.

Table 3-1: System Parameters

Parameter	Value
Nominal System Voltage	11 kV
Highest System Voltage	12 kV
Rated Voltage	12 kV
System frequency	50 Hz
Number of Phases	3 Phase/3 Wire

Table 3-2: Circuit Breaker Parameters

Parameter	Value
Lightning Impulse Withstand Voltage Phase-to-Phase & Phase-to- Earth: Across Isolating Distance:	 75 kV (peak) 85 kV (peak)
Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening Span Across Isolating Distance	 28 kV rms for 1 minute 32 kV rms for 1 minute
Rated Short Time Withstand/Breaking Current:	20 kA (rms)
Rated Duration of Short Circuit:	3 seconds
Rated Normal Current:	400 Amps (rms)

Table 3-3: Load Break Switch Parameters

Parameter	Value
Rated Short Circuit Making Capacity	50 kA peak at rated voltage (both LBS & Earthing Switch)
Rated Load Interrupting Current	630 Amps
Rated Cable Charging Interrupting Current	25 Amps

The RMU switchgear shall be capable of withstanding the specified currents without damage in accordance with the latest versions of IEC 60694 (Common Specifications for High-Voltage Switchgear and Control Gear Standards) and IS 3427 (AC Metal Enclosed Switchgear and Control Gear for Rated Voltages above 1 kV and up to and including 52 kV).

3.2.1 Design Details

- The RMU shall be designed to operate at the rated voltage of 12 kV. It shall consist of two (2) numbers of 630 Amp SF_6 insulated Load Break Switches as incomers and up to three (3) numbers of 400 Amp SF_6 insulated Circuit Breakers.

- It shall include, within the same metal enclosure, earthing switches for each Load Break Switch and Circuit Breaker.
- Suitable fool-proof interlocks shall be provided to the earthing switches to prevent inadvertent or accidental closing when the circuit is live and the concerned Load Break Switch/Circuit Breaker is in its closed position.
- Cast-resin enclosures filled with gas at suitable pressure to ensure adequate insulation and safe operation shall be used. The assembly shall not require further gas processing during its expected operational life of 30 years as per Clause GG 2.3 and 3.3 of IS 3427.
- The degree of protection required against prevailing environmental conditions, including splashing water and dust, shall be not less than IP 54 as per IS 12063.
- The active parts of the switchgear shall be maintenance free. Otherwise, the RMU shall be of low-maintenance type.
- The tank shall be made of an adequate thickness of stainless steel or metallised cast resin and shall be internally arc tested.
- The RMU shall be suitable for mounting on its connecting cable trench.
- For each RMU enclosure, a suitably sized nameplate clearly identifying the enclosure and the electrical characteristics of the enclosed devices shall be provided.
- The positions of the different devices shall be clearly visible to an operator when standing in front of each enclosure with its door open. Device operations shall be clearly visible.
- The RMU design shall be such that access to live parts shall not be possible without the use of Constructor-supplied tools.
- The design shall incorporate features that prevent any accidental opening of the earth switch when it is in the closed position. Similarly, accidental closing of a Circuit Breaker or Load Break Switch shall be prevented when the same is in an open position. This includes protection against accidental closing resulting from the release of any latch or spring in tension due to vibrations caused externally or internally.

3.2.2 Earthing

- There shall be continuity between metallic parts of the RMUs and cables so that there is no dangerous electric field in the surrounding air and the safety of personnel is ensured.
- The RMU frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.

- The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw suitable for the specified earth fault conditions. The connection point shall be marked with the earth symbol. The flexible connections between the earthing blade and the frame shall have a cross-section of at least 50 mm^2 copper or equivalent in aluminum.

- The Earthing Switch shall be fitted with its own operating mechanism. In this respect, manual closing shall be driven by a fast acting mechanism independent of the operator's action.

3.2.3 Incomer Load Break Switches

- The Load Break Switches shall be maintenance free. With enclosure doors open, the position of power contacts and earthing contacts shall be clearly visible from the front of the RMU.

- The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations.

- The switches shall be fully assembled, tested, and inspected in the factory.

- Manual opening and closing shall be driven by a fast-acting mechanism independent of manual operator action.

- The Load Break Switches shall be provided with a motorized operating mechanism suitable for SCADA control.

- A facility shall be provided with an electrical operating mechanism allowing an operator at the RMU site to operate the Load Break Switches without any modification of the operating mechanism and without de-energizing the RMU.

- The switch and earthing switch mechanisms shall have a mechanical endurance of at least 5,000 operations. Otherwise, these mechanisms shall conform to IS 9920 (High Voltage Switches Part 1: High Voltage Switches for Rated Voltages above 1 kV and less than 52 kV).

3.2.4 Circuit Breakers

The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with enclosure doors open, their positions shall be clearly visible. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921: Alternating Current Disconnectors (Isolators) and Earthing Switches for Voltages above 1,000 V.

The breakers shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.

An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There shall be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.

When the Circuit Breaker closing mechanism is of the spring operated type, it shall not be possible for the Circuit Breaker to close until the spring is fully charged and the associated charging mechanism is fully ready for closing. Wherever an external spring charging handle is required to charge the spring, it shall be ensured that the same is not allowed to move during release of the spring energy. Alternatively, it shall not be possible to release the spring energy until the charging handle is completely disengaged from the mechanism. A visual mechanical indicating device shall be provided to indicate the status of the spring, i.e., SPRING CHARGED or SPRING FREE. It shall be possible to charge the spring when the Circuit Breaker is closed and, if the spring is released, the Circuit Breaker shall not open. Nor shall this operation result in any mechanical damage to the component of the Circuit Breaker or its operating mechanism. Alternatively, a fast acting reflex mechanism for Circuit Breakers is also acceptable.

Each Circuit Breaker shall operate in conjunction with a suitable protection relay under lateral circuit phase and earth fault conditions. In addition, the Circuit Breaker shall be provided with a motorized operating mechanism that can be remotely controlled by the DAS.

3.2.5 Cable Termination

Bushings shall be conveniently located for working with the specified cables and shall allow for the termination of these cables in accordance with the prevailing practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601.

A non ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the RMU. Special clamps to avoid mechanical load of the terminated cable on the bushing.

A suitable arrangement for the Circuit Breakers, Earthing Switches, and Load Break Switches shall be provided so that these devices can be padlocked in the "Open" and "Closed" positions.

A permanent "Live Cable" indication as per IEC 61958 (High-Voltage Prefabricated Switchgear and Control Gear Assemblies - Voltage Presence Indicating Systems) shall be provided for each cable using a capacitor voltage divider.

It shall be possible to test the core or sheath insulation of the cables without de-energizing the remaining section of the RMU, accessing the cable compartment, or disconnecting the cable.

3.2.6 Safety of Equipment

With respect to the RMU's SF_6-filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the enclosure so that the gas will be released away from the operator without endangering the operator or anyone else in the vicinity of the RMU.

All manual operations shall be carried out from the front of the RMU. The effort required to be exerted on the lever as used by the operator shall not exceed 250 N.

3.2.7 Front Plate

The front plate shall include a clear mimic diagram indicating RMU functionality. The position indicators shall correctly depict the position of the main contacts and shall be clearly visible to the operator. The lever operating direction shall be clearly indicated.

3.3 Line sensors

The RMU shall be provided with current sensors and voltage sensors. These sensors shall meet the electrical and mechanical ratings as per the relevant standards referenced in Table 1-1.

3.3.1 Current Sensors

A panel shall be provided in each load break switch enclosure to mount a three-phase, single-core, CT for metering purposes. A similar panel shall be provided in each circuit breaker enclosure to mount a three-phase, single-core, CT for protection purposes. CT access for maintenance or any other purpose shall be from the front, back, or top of these panels.

The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.

Further characteristics and features distinguishing CTs used for metering from CTs used for protection are listed as follows:

CTs for Metering:

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 400-200/1 A
- Accuracy Class: 0.5

CTs for Protection:

- Material: Epoxy resin cast

- Burden: 2.5VA
- Ratio: 200-100/1 A
- Accuracy Class: 5 P 10

The RMU's other CTs, i.e., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI.

3.3.2 Voltage Sensors

Three (3) potential transformers shall be provided. The burden per transformer shall be no more than 50 VA and the voltage ratio shall be 11000/110 V. The accuracy class shall be 0.5. HRC fuses shall be provided on the HV side.

The PTs shall be of cast epoxy-resin construction, and they shall conform to IS 3156. Their design and construction, in particular, shall be sufficiently robust to withstand the thermal and dynamic stresses during short circuits.

3.4 Fault Passage Indicator

Each RMU shall be outfitted with one non-communicable FPI. The FPI shall be mounted in the nominal outgoing OD (Load Break Switch) enclosure along with its integral CT for phase and earth fault monitoring.

The FPIs shall include:

- Fault indicator units for feeder phase and earth faults.
- Potential-free output contacts for hardwiring to RTUs. On this basis, the DAS will be able to monitor fault passage indications. Two such output contacts per FPI are desirable, one for phase and one for earth fault monitoring.
- Potential-free input contacts for hardwiring to RTUs to allow the DAS to reset FPI's following their detection of phase or earth faults.
- Configuration ports for configuring the equipment in the field. Such ports are desirable, but not mandatory.

Local fault indications shall be provided in addition to remote indications through the RTU. The local indications shall use LEDs on the front panel of the RMU enclosure.

The characteristics of the FPIs shall include:

- Phase fault thresholds configurable from at least 100 to 600 A
- Earth fault thresholds configurable from at least 20 to 100 A
- Number of steps for adjusting phase and earth fault thresholds at least four
- Fault current duration range configurable from at least 40 ms to 500 ms

- Protection Relay

The RMU shall be equipped with numerical relays as used to trip the RMU circuit breakers.

3.4.1 General

The Circuit Breaker enclosures in the RMU shall be outfitted with a communicable-type numerical (feeder protection) relay, i.e., one for each outgoing circuit breaker. The protection relay's auxiliary contacts shall be hardwired to the RTU. The relay shall also interface with the RTU via an RS 232/485 port in order to send, as a minimum, real-time phase current readings using the MODBUS protocol.

The numerical relay shall be powered by the RMU's power supply unit and be provided with Inverse Definite Minimum Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:

- Phase Overcurrent Protection (50/51)
- Earth Fault Protection (50N/51N)

The feeder protection relay shall be provided with an input for remote tripping, which shall be realized via an electric output pulse even without presence of phase current. A flag indicator shall be installed for signaling the occurrence of trip conditions.

3.4.2 Features and Characteristics

The numerical relay shall have the following minimal features and characteristics noting that variations may be acceptable as long as they provide similar or better functionality and/or flexibility:

- It shall be housed in a flush mounting case and powered by the RMU power supply unit.
- The Relays shall be of 24V DC auxiliary type.
- It shall have three phase overcurrent elements and one earth fault element.
- IDMT trip current settings shall be 20-200% in steps of 1% for phase overcurrent and 10-80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase overcurrent and 100-1200% in steps of 100% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase overcurrent and earth fault shall be supported.
- For IDMT delay multiplication, the Time Mutiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.1 steps.
- The relay shall have local independent LED indications for Healthy, Trip, I>, I>>, IN>, and IN>> conditions.
- The relay shall also be provided with:

- Alphanumeric Liquid Crystal Display (LCD) for measurement and relay setting.
- Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the DAS) with phase current measurements. It is also desirable that this same means of communication can be used by the RTU to send setting and control commands to the relay.
- Front USB port for local communications with a laptop PC.
- Parameter change capability that is password protected.
- Capability to record up to 5 of the latest fault records duly time stamped and stored in non-volatile memory for subsequent reading via the above referenced USB port.

3.5 Power Supply

Each RMU shall be outfitted with a power supply, including batteries and battery charger, suitable for operation of a 5-way RMU even if the RMU, for example, is only 3-way. This is to allow for the possible addition of future automated VLs. On this basis, the following operational specifications shall apply:

- The power supply unit shall conform to the following requirements:
  - Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC
  - Output: Stable 24 V DC and 12 V DC
  - Batteries: 24 V DC and 12 V DC
  - Receptacles: 2 x 230 V AC (for test equipment)
  - Lighting Fixtures: One for each enclosure
- The auxiliary power transformer's inputs shall be equipped with surge protection devices in accordance with IEC 62305.
- The 24 V DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 4 hours:
  - RMU's spring-charge motors for a minimum of six (6) operations
  - RMU's trip coils, close coils, FPI, multifunction meters, and relays
  - RTU as supplied by others
- The 12 V DC batteries shall have sufficient capacity to supply power to the radio (as supplied by others) with a nominal backup of 8 hours.
- The batteries shall be of sealed lead acid VRLA or dry type and shall have a minimum life of five (5) years at 25°C.
- The battery charger shall be fully temperature compensated.
- To prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user-adjustable time period or when the battery voltage falls below a preset value. If the battery voltage falls below the preset value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.
- An automatic battery checking device shall be provided to check the battery's health and initiate a battery-failed alarm signal in case battery deterioration is detected. Such detection may be based on comparing measurement values with set values (e.g., internal resistance, voltage, etc.).

- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the DAS to account for any of the following conditions:
  - Low battery voltage
  - High battery voltage
  - Battery failed
  - Battery charger overvoltage
  - Grounded battery/battery-charger
  - Others according to manufacturer's design

3.6 Multi-Function Meter

The RMU main incoming and outgoing OD circuits shall be equipped with Intelligent Electronic Devices (IEDs) in the form of communicable multi-function meters capable of providing distribution system voltage, current, power factor, power, and energy readings.

3.6.1 Operational Features

The multi-function meters shall have an accuracy class of 0.5 and shall provide data on an RS 232/485 communications port using the MODBUS protocol.

Each multifunction meter shall have the following minimum features:

- It shall be housed in a flush mounting case & powered by the RMU DC power supply unit.
- Measurement, display, and communications capability of up to 31 parameters
- THD measurement and power quality data
- True rms measurement
- Digital communications
- Fully programmable PT and CT ratios
- Simple menu driven interface
- High quality LED display
- Able to monitor:
  - Voltage: line-to-line and line-to-neutral
  - Current: phase and neutral
  - Frequency
  - Power factor
  - Power (active, apparent, and reactive)
  - Energy (active and reactive)
  - Total harmonic distortion

3.6.2 Specifications

The following table summarizes the specifications applicable to the multi-function meter.

Table 3-4: Multi-Function Meter Specifications

Parameter	Value
Input Voltage: Nominal input voltage (AC rms) Max continuous input voltage	 57.7 – 277 V L-N, 100 - 480 V L-L 120% of nominal value
Input Current: Nominal input current System CT primary values Max continuous input current	 1 or 5A AC rms (programmable on site) Standard values up to 4 kA (1 or 5 A) 120% of rated value
Overload Withstand: Voltage Current	 2 x rated for 1 sec, repeated 10 times at 10 sec intervals 20 x rated for 1 sec, repeated 5 times at 5 minutes
Operating Measuring Ranges	5 to 120% of rated value
Current	5 to 120% of rated value
Frequency	40 to 70 Hz
Power Factor	0.5 lag to 0.8 lead
Accuracy Reference Conditions: Reference temperature Input waveform Input frequency Auxiliary supply voltage Auxiliary supply frequency Power Factor	 23°C ± 2°C Sinusoidal (distortion factor 0.005) 50 or 60 Hz ±2% Rated Value ±1% Rated Value ±1% 0.866 lag to 0.866 lead
Accuracy: Voltage Current Frequency Active Power Re-Active Power Apparent Power Active Energy (kWh) Reactive Energy (kVArh) Apparent Energy (kVAh) Phase Angle and Power Factor	 ±0.5% over 50 to 100% of rated value ±0.5% over 10 to 100% of rated value 0.15% at mid frequency ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% 1%
Applicable Standards: EMC Immunity Safety IP for water and dust	 IEC 61326 IEC 61000-4-3 (10V/m minimum, Level 3) IEC 61010-1-2001 (permanently connected use) IEC 60529
Environmental: Operating temperature Relative humidity	 -10 to +55°C 0 to 90% non-condensing

3.7 Distribution Automation System Interface

The RMU shall be equipped so that it can be monitored and controlled via the DAS. In this respect, it shall interoperate with the RTU that will be housed in the RMU Control Cabinet. The RTU in turn will interoperate with the DAS via the remote radio and the communications system to which the radio is linked.

The RMU shall have provisions for opening and closing its switches using output from the RTU. The RMU shall also supply analog and status signals to the RTU for monitoring the condition of the RMU's distribution network circuits as well as the components of the RMU. A list of input/output points required for 3-way and 5-way RMU configurations is presented in Table 3-5 below.

Table 3-5: Data Points per RMU Configuration

3-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
LBS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open Miscellaneus ▪ SF_6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed, etc. **Total (with spare): 40**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open FPI ▪ Reset **Total (with spare): 8**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (One protection relay). Minimum No. of Points: ▪ 3 points per relay **Total Points: 3**

4-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
LBS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open CB2 ▪ CB 2: closed ▪ CB 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ Overcurrent relay 2: operated ▪ Earth fault relay 2: operated ▪ CB 2: local/remote status ▪ Door: open Miscellaneus ▪ SF_6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed, etc. **Total (with spare): 47**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open CB 2 ▪ CB 2: close ▪ CB 2: open CB 3 ▪ CB 3: close ▪ CB 3: open FPI ▪ Reset **Total (with spare): 16**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (3 protection relays). Minimum No. of Points: ▪ 3 points per relay **Total Points: 9**

5-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
LBS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open CB2 ▪ CB 2: closed ▪ CB 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ Overcurrent relay 2: operated ▪ Earth fault relay 2: operated ▪ CB 2: local/remote status ▪ Door: open CB3 ▪ CB 3: closed ▪ CB 3: open ▪ Spring 3: charged ▪ Earth switch 3: closed ▪ Earth switch 3: open ▪ Overcurrent relay 3: operated ▪ Earth fault relay 3: operated ▪ CB 3: local/remote status ▪ Door: open Miscellaneus ▪ SF_6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed, etc. **Total (with spare): 56**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open CB 2 ▪ CB 2: close ▪ CB 2: open CB 3 ▪ CB 3: close ▪ CB 3: open FPI ▪ Reset **Total (with spare): 16**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (3 protection relays). Minimum No. of Points: ▪ 3 points per relay **Total Points: 9**

3.7.1 Multi-Function Meter Interface with RTU

The Contractor is required to furnish the RMU meter information that pertains to interfacing the meter with the RTU through an RS 232/485 serial communications link. The protocol details along with the MODBUS mapping data as implemented in each meter shall be provided. In this respect, the Contractor in cooperation and coordination with the RTU contractor shall share the responsibility of ensuring effective communications is attained between the meter and RTU, i.e., all parameters read by the meters shall also be immediately available to the RTU.

3.7.2 Numerical Relay Interface with RTU

The Contractor is required to furnish the numerical relay information that pertains to interfacing the relay with the RTU through an RS 232/485 serial communications link. The protocol details along with the MODBUS mapping data as implemented in each relay shall be provided. In this respect, the Contractor in cooperation and coordination with the RTU contractor shall share the responsibility of ensuring effective communications is attained between the relay and RTU, i.e., all parameters read by the relay shall also be immediately available to the RTU.

3.8 Construction

The RMU shall be sufficiently sturdy to withstand handling during shipment, installation, and start-up without damage. The configuration for shipment shall adequately protect the RMU equipment from scraping, banging, or any other damage. The Contractor shall assume responsibility for correction of all such damage prior to final acceptance of the equipment.

3.9 Enclosures

All Contractor-supplied enclosures shall be sized to provide convenient access to all enclosed components. It shall not be necessary to remove any component to gain access to another component for maintenance purposes or any other reason.

The enclosures shall also be designed to ensure that the enclosure remains rigid and retains its structural integrity under all operating and service conditions with and without the enclosure door closed.

If made from stainless steel (304L or 316L), the thickness of the enclosure panels shall be at least 1.5 mm. Otherwise the thickness of all enclosure panels shall be at least 2 mm.

The appropriate corrosion treatment and finish requirements of Clause 2.2.2 shall apply to both inside and outside enclosure surfaces. Other required features are as follows:

- Constructed of stainless steel (304L or 316L) according to IEC 60529 with IP rating 54 or better. Alternatively, the RMU metal parts shall be made of high thickness high tensile steel which must be grit/shot blasted, thermally sprayed with Zinc alloy, phosphate, and subsequently painted with polyurethane based powder paint, the overall paint layer thickness including Zinc spraying shall be of the order of 100 to 130 microns.

- Means, such as insulated heat shields and/or air vents, to prevent high temperatures from damaging the RMUs enclosed components. If air vents are installed, these vents shall in no way reduce the effectiveness of the enclosure's protective characteristics.

- A metal pocket attached to the inside of the front door to hold documentation, maintenance log sheets, and other such information.

- Door opening mechanism with built-in key-lock facility suitable for padlocking. An opening mechanism that is less prone to breaking than a projecting door handle is preferred, e.g., a push-button opening mechanism.

- A grounding terminal including grounding bolt and lock washer for connecting a 50 mm^2 galvanized steel grounding conductor. The grounding bolt and lock washer shall be made of stainless steel.

- Means of preventing moisture from condensing on electronic components mounted inside the enclosure proposed for housing the RTU. If necessary, heaters providing adjustable thermostat-control within the range 20 to 60 °C shall be installed in the enclosure for this purpose.

- Means of protection against rain water, corrosive salt formations, and high levels of airborne dust.

- Means of enabling the DAS to monitor the open/closed status of the enclosure door. A DAS equipment alarm shall be produced whenever the enclosure door is open.

3.10 Control Cabinet

The RMU shall be outfitted with a separate enclosure, referred to herein as the Control Cabinet, to house the following equipment as a minimum:

- Auxiliary transformer
- SCADA terminal blocks
- Power Supply Unit including Charger and Batteries
- RTU (supplied and installed by others)
- Radio (supplied and installed by others)
- Multi-pin connector consisting of plug and socket fittings and angled terminal block
- Other equipment according to manufacturer's design

The Control Cabinet shall be similar in style and finish as the other RMU enclosures. This shall include having a minimum protection class of IP 54. It shall be tested in accordance with the latest IEC 60529 standard.

The cabinet shall have a hinged front access door with a three-point latch locking system and a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or

neoprene) to prevent the entrance of water. In addition, a means of monitoring and indicating that the door is open shall be provided.

A metal screen with holes shall be provided on the top and bottom of the control cabinet to provide ventilation aimed at avoiding condensation inside. Venting however shall in no way reduce the effectiveness of the control cabinet's water-tight, dust-tight, and corrosion-resistant characteristics. To augment the cabinet's effectiveness in preventing the ingress of dust, insects, vermin, and small objects, all electronic parts within the control cabinet shall be enclosed in modules. Such parts and modules shall be separated from the power supply modules as also installed in the cabinet.

The Control Cabinet shall include a weather-sealed hole with a double compression cable gland, approximately 30 mm in diameter, on the top of the cabinet for routing an antenna cable that will be supplied and installed by BESCOM. This will enable the cable to connect the radio housed in the cabinet to its externally mounted antenna. To house the radio, and the RTU to be supplied and installed by BESCOM, the Control Cabinet shall include a minimum contiguous space of 600 mm (W) x 500mm (D) x 600 mm (H).

If made from stainless steel (304L or 316L), the thickness of the enclosure panels shall be at least 1.5 mm. Otherwise the thickness of all enclosure panels shall be at least 2 mm.

The control cabinet shall also be provided with:

- Weatherproof fittings for control cables.
- **Provision for handle and padlock. In addition to this, a Metal number lock of adequate size shall be provided.**
- Grounding terminal, with solderless clamp type connector suitable for steel stranded conductor of suitable diameter and complete with lock washer of stainless steel or better.
- Provision for separately grounding the RMU's electronic items.
- Thermally controlled small fan for circulating air when necessary to maintain temperatures within the Control Cabinet to acceptable levels.
- Circuit diagram of control unit for maintenance purpose affixed permanently.
- Others according to manufacturer's design.

3.11 Auxiliary Transformer

The RMU shall be outfitted with a single-phase auxiliary power transformer with a turns ratio of 11000/sqrt (3) to 230, i.e., it shall be connected line-to-neutral to the RMU 11 kV bus and used to provide the required 230 V AC input to the RMU's power supply. The auxiliary power transformer shall have a capacity of at least 1,000 VA. During project implementation, however, the Contractor shall assess this requirement by taking into account the actual load corresponding to the RTU and radio (supplied by others) as well as the load represented by the RMU motors, etc. In this respect, with a suitable margin approved by the Employer, the auxiliary transformer must be capable of

supporting the power supply requirements that correspond to a 5-way RMU. HRC fuses shall be provided on both the HV and LV sides of the transformer.

3.12 Motors

The RMU shall be retro-fitted with spring charge motors of insulation Class E or better allowing the circuit breakers and load break switches to be operated without manual intervention. Motor speed shall ensure springs can be charged within 1 to 2 seconds. Independently of DAS control, the mechanism shall ensure that the motors start up immediately once the spring becomes discharged, so that the breaker becomes ready for the next operation.

In addition to allowing circuit breaker tripping by the RMU's protection relays, the motorized operating mechanism shall be suitable for remote control by the DAS.

The motors along with a Contractor supplied control panel shall allow Employer personnel to electrically operate the circuit breakers and load break switches at site without any modification of the operating mechanism and without de-energizing the RMU.

The motors shall be of a reputable make in the form of a universal 24 V DC type. They shall be enclosed and completely dust proof and sized with a suitable margin to meet the torque requirement of the spring charge mechanism.

4 Inspection and Test

Inspections and tests shall be performed to ensure RMU compliance with these Technical Specifications. Responsibility for conducting the inspections and tests shall rest with the Contractor. The Employer will participate in the RMU inspections and will witness the testing as described in the following sub-clauses.

4.1 Inspections

Employer representatives shall be allowed access to any Contractor or other facility where the RMU or its parts are being produced or tested. Such access will be used to verify by inspection that the RMUs are being or have been fabricated and tested in accordance with the Technical Specifications.

The Contractor shall give the Employer 15 days notice in writing concerning the date and place at which the equipment will be ready for inspection or testing. The Contractor shall provide all the necessary assistance and facilities to Employer representatives to carry such inspections and test witnessing.

The Employer representatives will also visit Employer sites where the RMUs have been delivered and are being or have been installed and tested to ensure the installations and testing are proceeding or have been completed in the manner intended.

The Contractor shall provide any and all documentation that is necessary to complete the inspections. The Employer shall be allowed to inspect the Contractor's quality assurance standards, procedures, and records. Inspections, as a minimum, shall include checks on inventory, general appearance, cabling, drawing conformance, and labeling.

Where applicable, the Employer's inspections will be performed in conjunction with witnessing the RMU tests. The Contractor shall take all necessary steps to address and resolve any concerns that Employer representatives may raise as a result of these activities in a timely fashion.

This may result in further inspections and tests until the representatives are fully satisfied that the inspections and tests have been completed successfully.

4.2 Test Procedures

The Contractor shall provide test plans and detailed procedures for all required testing. The plans and procedures shall ensure that each test is comprehensive and verifies proper performance of the RMU under test and, in this respect, shall be submitted for review and approval by the Employer.

The test plans shall include all routine tests and acceptance tests as per relevant BIS/IEC standards and shall describe the overall test process including the responsibilities of the test personnel and how the test results will be documented.

The test procedures shall describe the individual tests segments and the steps comprising each segment, particularly the methods and processes to be followed.

4.3 Test Reports

The Contractor shall maintain complete records of all test results. The records shall be keyed to the test procedures.

Upon completion of each test, the Contractor shall submit a test report summarizing the tests performed and the results of the tests. The test report shall include the following information:

- Test Log - A chronological record of all events related to execution of the tests.
- Test Incident Report – A detailed description of any event during the testing process that required investigation.
- Test Summary Report – A presentation of results pertaining to the designated test activities and a summary of all relevant recommendations and conclusions based on these results.
- Variance Report – A summary of the problems detected during testing and the corresponding resolutions.
- Official Certification – A formal declaration that the required testing was performed and, if applicable, was completed successfully.
- Signatures – As designated representatives of the Contractor and/or Employer, the signatures of witnesses for each completed test, whether successful or not successful, along with relevant dates. Witness names and contact information shall also be provided.

4.4 Type Tests

These tests shall be conducted on RMUs representative of the actual RMUs to be supplied and installed in the BMAZ distribution network such as an existing product capable of meeting the Employer's requirements or a proto-type product designed and developed during project implementation with the express intent of meeting these requirements.

The tests shall take place prior to full-scale manufacture of the deliverable RMUs and shall be performed at an accredited third-party test laboratory selected by the Contractor. The selected test laboratory shall require approval by the Employer. The type tests may not need to be carried out if the Contractor furnishes, along with the bid, type test certificates corresponding to relevant testing within the last five years from the date of bid submission. Failure to conform to this requirement shall constitute grounds for rejection of the bidder's proposal.

4.5 Factory Acceptance Test

A formal factory acceptance test shall be conducted to ensure that the RMUs have been designed to meet the Employer's functional requirements in all respects. Employer representatives shall witness the test on a representative RMU, and the test shall be carried out in accordance with the Contractor's test plan and procedures as approved by the Employer. Should the factory acceptance test prove

unsatisfactory in any way, the Employer reserves the right to have further tests conducted and, if applicable, request further improvements in the Contactor's RMU design.

To the extent possible, the test shall demonstrate the capability of the RMU to interoperate with the RTU to be supplied by BESCOM. It is also the intent of the Employer that the test shall make use of the Data Acquisition (DAC) Simulator to be supplied by BESCOM. The DAC Simulator (representing the DAS) together with the RTU will reduce the risk of discovering interoperability problems subsequent to RMU installation at site. Thus, in preparation for the factory acceptance test, the Contractor shall make every effort to cooperate and coordinate all such activities with these other contractors.

4.6 Routine Factory Tests

These tests shall be carried out during RMU manufacture as a quality control measure, i.e., to ensure each RMU to be delivered meets the Employer's minimum requirements including all relevant standards. Recording and reporting the routine test results shall be the responsibility of the Contractor.

At the Employer's discretion, Employer representatives will witness such testing. This may include requesting the Contractor to perform tests on RMUs selected at random from each batch of RMUs that the Contractor deems ready to be delivered to site. Should any such test prove unsatisfactory, the Employer reserves the right to have further tests conducted and for delivery not to take place until a mutually agreed course of action has been reached.

4.7 Field Performance Tests

4.7.1 Unit Test

Each and every RMU shall be tested at site. This shall include unit testing by the Contractor at the time of installation of each RMU to ensure all components can be powered up and are in good working order.

4.7.2 Site Acceptance Test

Each RMU shall undergo a Site Acceptance Test (SAT) to demonstrate to the Employer that the RMU is fully operational with respect to its functional capabilities and intended use at its specifically assigned site. In this respect, site acceptance testing shall be carried out in such a way as to verify that the RTU can be used to monitor and control the site's associated distribution network devices.

Such testing shall be conducted in a way that will minimize power interruptions. Any need for power interruptions in order to conduct the testing shall be arranged in full and timely coordination with the Employer's system operations staff. Otherwise, the functional capabilities shall be exercised using non-outage techniques such as simulating analog and status inputs and checking for control output signals at points of connection that may need to be temporarily isolated from the distribution network.

During SAT, it shall be demonstrated that the RMU and RTU can interoperate successfully in all respects. To this end, the intent is to make use further use of the DAC Simulator to be provided by the

DAS supplier. Thus SAT shall verify that the RMU interface is fully operational and capable of meeting or supporting all applicable DAS functional performance requirements.

4.7.3 RMU Commissioning

The end-to-end tests for RMU operations and communicability features of the relay and meter shall serve as a means of commissioning the RMU. The Contractor, therefore, shall support end-to-end testing by having adequate Contractor personnel on hand to witness these tests in consultation with DAS.

Prior to starting the warranty period, the Contractor shall submit a report clearly identifying the results of all end-to-end tests from the perspective of the RMUs. This shall include a summary of the variances detected and whether or not these variances were successfully corrected. Where necessary, for Employer consideration, the report shall include the Contractor's plan for resolving any and all variances not yet corrected.

No RMU installation shall be accepted as complete until the Employer is satisfied that all variances associated with an individual site have been corrected and that the RMU is SCADA ready, i.e., can be considered fully integrated with the DAS.

Documentation

It is the intent of the Employer to become self sufficient in all aspects of the field device. In order to assure that the Employer has the opportunity to become self sufficient in a timely and orderly manner, it is necessary that the Contractor provide high quality documentation.

4.7.4 Equipment Manuals

Equipment manuals shall contain the following:

- Description of the function of the equipment
- Installation, setup, and operating instructions
- Block diagram showing logical and physical interconnections among major components
- Expansion and upgrade capabilities and instructions
- Preventive maintenance instructions
- Detailed functional, logical, electrical, and mechanical characteristics of all equipment including protocol descriptions
- Troubleshooting and repair guides, including descriptions and instructions for the diagnostics furnished

4.8 Operating Manuals

The Contractor shall submit, for review and approval, operating manuals for all RMU components including items such as FPI, Relay, and MFM. These manuals shall be in English. They shall include

the RMU operating instructions. Context sensitivity shall be used to go directly to the appropriate place in the manual.

The manuals shall be organized for quick access to each detailed description of the operator procedures that are required to interact with the RMU functions. This shall include the procedures to define, build, edit, and expand all data points provided with the RMU.

The manuals shall present in a clear and concise manner all information that operators, including maintenance personnel, need to know to understand and operate RMUs satisfactorily. The manuals shall make abundant use of diagrams and/or photographs to illustrate the various procedures involved.

4.9 As-Built Documents and Drawings

The Contractor shall submit as built documents including applicable drawings for review and approval. All deliverable documents and drawings shall be revised by the Contractor to reflect the as-built RMU components including all the FPI, Relay, and MFM devices. Any errors in or modifications to an RMU resulting from its factory and/or site acceptance test shall be incorporated. Within this same context, all previously submitted documents that are changed because of engineering changes, contract changes, errors, or omissions shall be resubmitted for review and approval.

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20 Three Phase 4 Wire L.T. Distribution Box for Aerial Bunched Conductor

1 **SCOPE**:

1.1 The L.T. Distribution Box shall be used for connection through overhead conductors or ABC line and for giving connections to the consumers. This specification covers the design, manufacture, inspection, testing and supply of L.T. Distribution Box. The L.T. Distribution Box will be installed at the Poles and it shall withstand solar radiations, rain, wind pressure and pollution.

2 **CONSTRUCTIONAL AND TECHNICAL PARTICULARS**:

2.1 The Distribution Box shall be made from 20 SWG CRCA MS sheet by **Deep Drawn Method with Powder Coating.** Size of the box shall be 418mm x 300mm x 120mm as shown in drawing. There shall not be any welding joint to make base and cover of the Distribution box. Roof of the box shall be tapered on both sides to drain the rain water.

2.2 Distribution box shall have Insulated Multiple Outgoing Connectors for R, Y, B Phases and Neutral. Distribution box shall have arrangement for one incoming cable of three phase of size up to 4core 35mm². Arrangement for four outgoing cables of size up to 4core 16mm² for three phase connection shall be provided in the distribution box. Each Incoming & outgoing cable shall be fixed inside the connection terminals by two screws of size not less than M8. The connection terminals shall be such that the outgoing cables can be fixed or removed easily without disconnecting the power supply. No current carrying part shall be approachable by hand or finger. Any current carrying part should be at a minimum distance of 5mm from the outer edge of the insulation. Insulation shall be Fire retardant.

2.3 Connection terminals for R, Y, and B Phases shall be mounted horizontally in a single line and Neutral shall be mounted parallel to R, Y, and B Phases in stepped pattern. Mounting arrangement shall be such that minimum clearance of 40mm is maintained between each phase and neutral. Fixing of connection terminals with the distribution box shall be preferably non-removable type to avoid theft of connection terminals.

2.4 Box shall be provided with U-latch sealing arrangement. A hole of 8mm & 2.5mm shall be provided in the U-latch to provide a padlock & sealing of the box respectively. U-latch shall be joined with stainless steel rivet.Box should be duly powder coated after 7-tank Phosphating process. Box should be of Light Admiralty Grey color (IS-5:1993, COLOUR NO-697). The L.T. Distribution box shall be powder coated only. The facility for 7-Tank Phosphating and powder coating shall be in-house of the tenderer to ensure proper quality, since these boxes are for outdoor applications.

2.5 4 Holes for incoming cables and 4 Nos. holes for outgoing cables shall be provided on the lower wall of the box. Cable holes shall be provided with rubber / plastic glands duly pasted with the box. Incoming and outgoing cable gland shall have internal diameter of 20mm. Cable Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the cable glands by piercing the film of the glands. Gap of minimum 100mm shall be maintained between the lower wall and neutral mounted inside the distribution box for easy handling of incoming and outgoing cables.

2.6 **MARKING**: Following shall be provided on the cover of box.

a) Manufacturers name duly embossed
b) Utility name duly embossed
c) Name of scheme duly embossed
d) Danger marking in red color.

2.7 M.S. Earthing Screw of diameter 6mm with washer shall be provided in the threads of the earth clamp welded to the main body of the box.

2.8 The box shall comply with the requirement of IP54. The box shall be fully type tested along with dimensional details as per the requirement of relevant Indian Standard (latest edition) IS13947: Part-I and latest amendments. Tests shall be carried out from laboratories which are accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India to prove that the complete box meet the requirement of IP54. The tests report shall be submitted along with the tender failing which the tender of the firm shall not be opened. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. The type test reports shall not be older than 5 years.

2.9 Distribution Box shall be duly packed in 3Ply corrugated box. The tolerance permissible on the overall dimensions of the MMB shall be (±) 3%.

3.0 TESTS:

Following tests shall be performed on the box during inspection:

3.1 **Visual Examination**:
The L.T. Distribution box will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.

3.2 **Verification of dimensions**:
Verification of dimensions, external / internal clearances will be carried out as per technical specifications.

3.3 **Verification of fittings**: Components like insulated connection terminals, screws etc will be verified as per technical specification.

3.4 **High voltage withstand test at 2.5KV**:
The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:
a) Between each Phase
b) Between each Phase and earth screw
c) On the insulation of connection terminals
There shall not be any puncture or flash over during this test.

3.5 **Current Carrying Capacity**: The Current of 200 AMP shall be applied for 30 minutes through high current source on the each Phase. There shall not be overheating of the terminals during this test.

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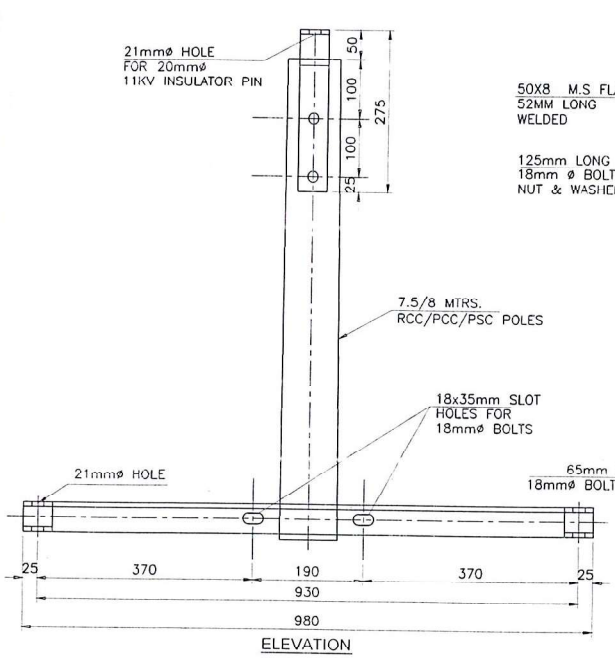
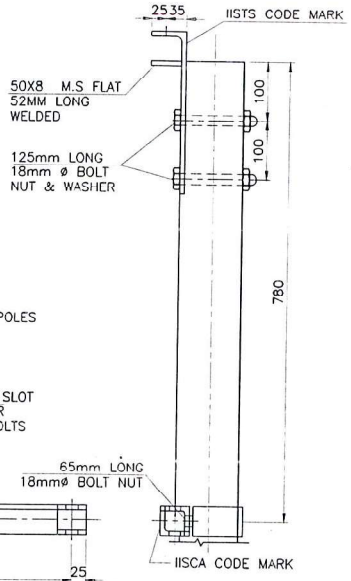
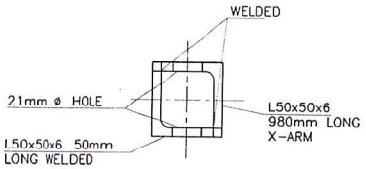


ELEVATION

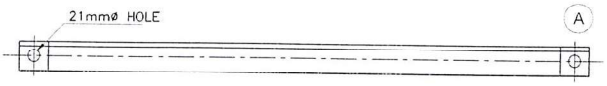




DETAILS AT-A

NOTES:-

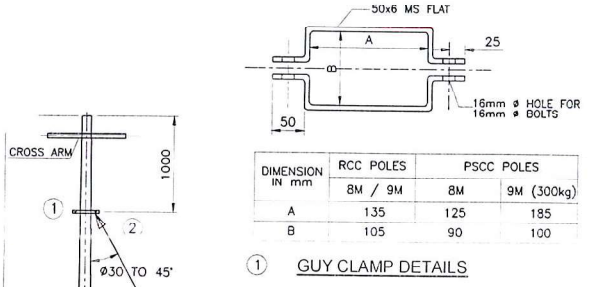
1. ALL HOLES ARE 18mm ø FOR 16mm ø BOLTS UNLESS OTHERWISE SPECIFIED.
2. ALL SLOTTED HOLES ARE OF 18x35mm LONG.
3. CLAMPS TO BE SELECTED DEPENDING UPON TYPE OF POLES USED.



PLAN

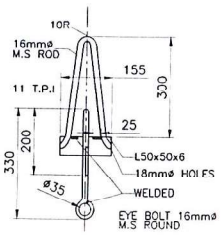
	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF 11KV SINGLE TOP SUPPORT & HORIZONTAL X-ARM	Approved General Manager.(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/01 REV-002 DATED:24-11-2018

88

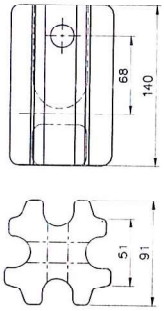


DIMENSION IN mm	RCC POLES	PSCC POLES	
	8M / 9M	8M	9M (300kg)
A	135	125	185
B	105	90	100

① GUY CLAMP DETAILS



② TURN BUCKLE
(Hot dip galvanised)



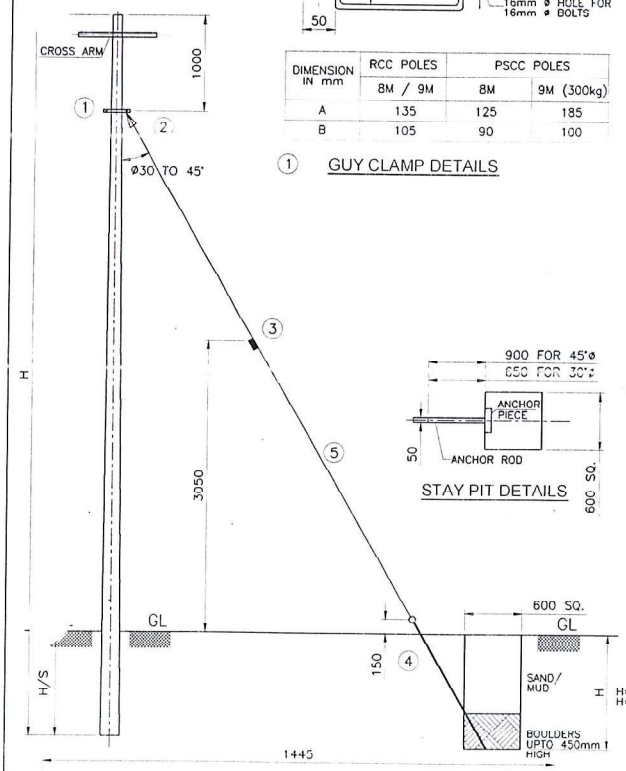
③ STRAIN INSULATOR

STANDARD PARTICULARS

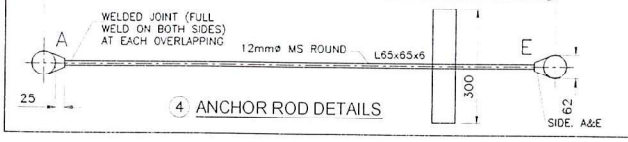
1. LEAKAGE DISTANCE IN mm 70
2. TENSILE STRENGTH IN KG. 3500
3. FLASH OVER VOLTAGES
   a) DRY KV 35
   b) WET KV 20
4. PUNCTURE VOLTAGE IN IN 50

ABSTRACT OF GUY KIT.

1. GUY CLAMP – 2 NOS. AS PER TABLE.
2. 16mmø 65mm LONG BOLT & NUT – 2 NOS.
3. TURN BUCKLE – 1 NO.
4. STRAIN INSULATOR – 1 NO.
5. ANCHOR ROD – 1 NO.
6. 7/3.15mm GUY WIRE AS PER TABLE.
7. TIMBLE TO SUIT 7/3.15mm GUY WIRE AS PER TABLE – 2 NOS.



STAY PIT DETAILS



④ ANCHOR ROD DETAILS

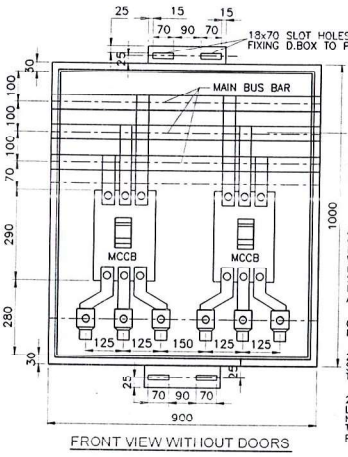
⑤ 7/3.15mm GUY WIRE REQUIREMENT

SL. NO.	RCC/PCC POLE LENGTH IN METERS.	LENGTH OF GUY WIRE REQUIRED IN METERS.	
		FOR 30°	FOR 45°
1	8.0	7.5	9.0
2	9.0	8.5	10.5

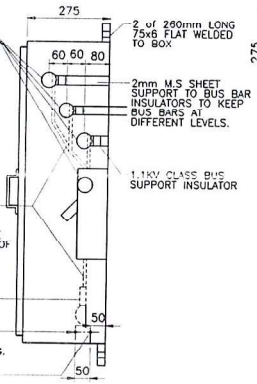
NOTES:-

1. LEAVE ABOUT 400mm EXTRA WIRE AT EACH BINDING.
2. UNSTRAND AND BEND EACH INDIVIDUAL STRAND FOUR TIMES AND CUT AWAY EXTRA WIRE.
3. USE TIMBLE AT ANCHOR ROD & EYE BOLT POINT TO AVOID DAMAGE TO GUY WIRE STRANDS.
4. THE CLAMPS SHOULD SUIT TO POLE C/S AS INDICATED IN TABULAR COLUMN AND THE. DIMENSIONS ARE WORKED OUT WITH THE FOLLOWING DRAWINGS AS BASIS.
   a) KEB/GPL/TL-SS/5, b) RCC/C1-01 c) MSEB-GPL-MISC 8&7 FOR RCC POLES AND d) KEB/GPL/MISC-97 FOR PCC POLES.
5. THE GUY WIRE TO BE SUPPLIED IN CUT LENGTHS AS PER TABULAR COLUMN. ENDS TO BE FIRMLY BINDED TO AVOID DE STRANDING.
6. GUY CONNECTING DOES NOT INVOLVE CEMENT, ONLY SAND AND STONE BOULDERS TO BE USED.

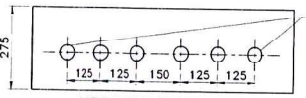
	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF GUY SET ACCESSORIES KIT	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRC.NO.BESCOM/GM/QS&S/07 REV-002 DATED:24-11-2018
	SCALE N.T.S		


25
15
15
70 90 70
18x70 SLOT HOLES FOR FIXING D.BOX TO POLE CLAMPS.
MAIN BUS BAR
4 HOLES OF 50mm ø FOR CABLE ENTRY ON EITHER SIDED WITH RUBBER/FIBRE GASKETS.
HOLES TO SUIT 16mmø 40mm LONG HEX. G.I BOLT & NUT WITH PLAN C.I WASHER & SPRING WASHER FOR FIXING ALUMINUM LUG.
MCCB
MCCB
125 125 150 125 125
70 90 70
900
1000

FRONT VIEW WITHOUT DOORS


275
2 of 280mm LONG 75x6 FLAT WELDED TO BOX
60 60 80
2mm M.S SHEET SUPPORT TO BUS BAR INSULATORS TO KEEP BUS BARS AT DIFFERENT LEVELS.
1.1KV CLASS BUS SUPPORT INSULATOR
ALUMINUM BUS BARS CONNECTING MAIN BUS BARS TO MCCB TERMINALS VARIES 25 TO 50mm WIDE DEPENDING UPON RATING OF SWITCH USED WITHOUT REDUCING SECTION AREA OF 200 SQ.mm
COPPER LUG SUITABLE FOR 240 SQ.mm CABLE.
2 NOS. 25mm ø GK SQUARE PLATE FIXED WITH TWO RIVETS OR EMBOSSING.
2 NOS. OF 8mm ø 40mm LONG G.I BOLT WITH TWO NUTS, ONE SPRING & TWO PLAIN WASHERS FOR EARTHING
50
50

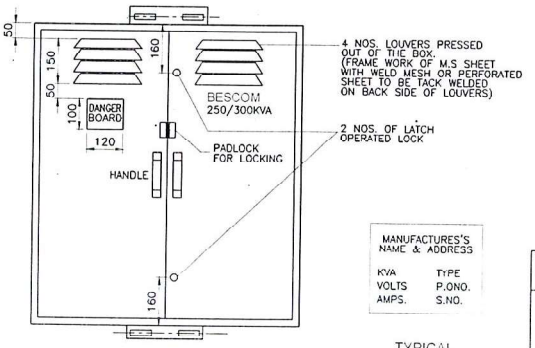
SIDE VIEW



VIEWED FROM BOTTOM

BILL OF MATERIALS

SL NO	PARTICULARS	QUANTITY	REFERENCE STANDARD
1	MOULDED CASE CIRCUIT BREAKER 60 KA (REPUTED MAKE) 250A	2 NOS.	IS-8828 & IS-13947
2.	EC GRADE EQ ALUMINUM BUS BARS WITH PVC INSULATED TOUCHNED/COMPOUND INSULATION COATING a) MAIN BUS BARS 50x10mm b) CONNECTION LINKS 40x18mm	 3 NOS. 12 NOS.	
3.	BUS SUPPORT INSULATORS 1.1KV CLAES	12 NOS.	
4.	M.S SHEET 2mm		
5.	PAINT: ADMIRAL GREY		IS-5
6.	DANGER BOARD 120x100mm	1 NO.	IS-2551
7.	GI BRASS BOLTS & NUTS FOR TERMINATION	12 NOS.	
8.	ALU-CU.BI METALLIC WASHERS	24 NOS.	
9.	SPRING WASHERS.	12 NOS.	


50
50 150
160
100
DANGER BOARD
120
HANDLE
BESCOM 250/300KVA
PADLOCK FOR LOCKING
4 NOS. LOUVERS PRESSED OUT OF THE BOX. (FRAME WORK OF M.S SHEET WITH WELD MESH OR PERFORATED SHEET TO BE TACK WELDED ON BACK SIDE OF LOUVERS)
2 NOS. OF LATCH OPERATED LOCK
160

FRONT VIEW

MANUFACTURES'S NAME & ADDRESS

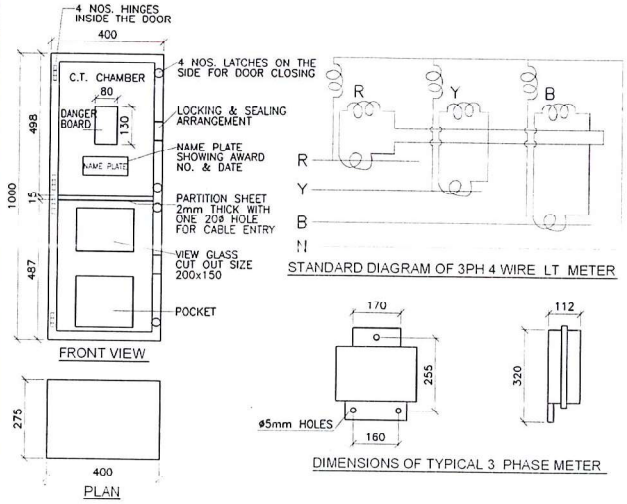
KVA TYPE
VOLTS P.ONO.
AMPS. S.NO.

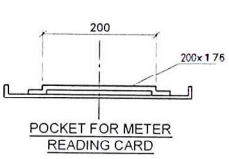
TYPICAL NAME PLATE DETAILS

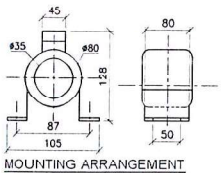
NOTES:-

1. ALL DIMENSIONS ARE IN mm ONLY.
2. BOX SHALL BE MADE OUT OF 2mm SHEET, DEGREE OF PROTECTION AS PER IP-53.
3. THE DOOR SHALL HAVE INTERVAL LOCKING ARRANGEMENT WITH SPRING LOADED LATCH OPERATED BY A COMMON KEY FOR ALL THE BOXES.
4. ALL M.S. BOLTS & NUTS PLAIN & SPRING WASHERS SHALL BE GALVANISED BY HOT DIP OR ELECTRO PLATED PROCESS.
5. EARTHING MUST BE DISTINCTLY INDICATED BY METALLIC LABEL OR EMBOSSED.
6. DIMENSIONS ARE CRITICAL, SUBJECT TO SLIGHT ALTERATIONS.
7. CABLE ENTRIES AND OUTLETS ARE OF 50mm ø HOLES COVERED WITH 2mm THICK M.S. SHEET SQUARE PLATES.
8. RIGOROUS RUST PROOFING PROCESS (3 IN 1 TREATMENT), DEGREASING, DERUSTING AND PHOSPHATING SHALL BE CARRIED OUT ON THE METAL BEFORE AND AFTER FABRICATION OF THE BOX AND BEFORE SPRAY PAINTING.
9. ALUMINUM LUGS SHOWN ARE NOT IN THE SCOPE OF SUPPLY.
10. THE DOORS SHALL BE OF SELF CLOSING TYPE WITH SPRING ARRANGEMENT.

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF L.T DISTRIBUTION BOX SUITABLE FOR 250/300 KVA TRANSFORMERS USING MCCB	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/08 REV-002 DATED:24-11-2018
	SCALE N.T.S		

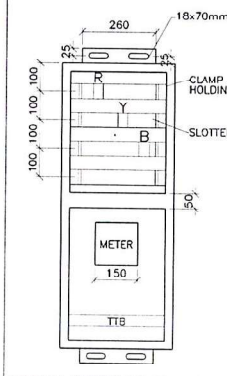


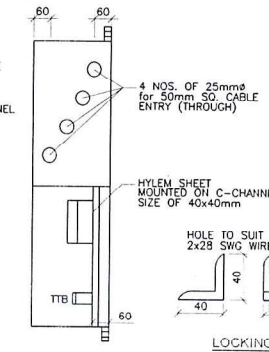




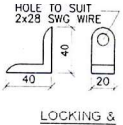
NOTES:-

1. SIZE OF BOX IS 1000x400x275mm.
2. DOORS TO HAVE LOCKING AND SEALING ARRANGEMENT.
3. VIEW GLASS 1 NO. SHALL BE TOUGHNED GLASS/POLY CARBONATE UV PROTECTED UNBRFAKABLE TYPE 210x160x6mm AND SHALL BE SUITABLE FOR OUTDOOR USE.
4. A POCKET FOR KEEPING THE READING CARD IN THE INNER SURFACE OF BOTTOM DOOR TO BE PROVIDED.
5. COVER SHOULD HAVE SEALING AND LOCKING ARRANGEMENT.
6. PROPER STIFNERS TO BE PROVIDED TO MAKE THE DOORS RIGID.
7. ALL HINGES, BOLTS & NUTS SHALL NOT BE VISIBLE.
8. SLOTTED ANGLE 40x40x2 TO BE PROVIDED FOR MOUNTING OF METER AND ACCESSORIES.
9. SHEET STEEL THICKNESS TO BE 2mm CRCA/M.S SHEET.
10. WELDED JOINTS SHALL BE FINISHED PROPERLY.
11. PAINT SHADE 631 OF I.S-5 (POWDER COATING)
12. RING TYPE C.Te WHOSE ACCURACY CLASS HAS TO BE ASSERTANED AND APPROVAL OBTAINED BEFORE SUPPLYING THE METER BOX.
13. SUITABLE GLANDS TO BE PROVIDED FOR CABLE ENTRY.
14. DEGREE OF PROTECTION IP-53.
15. USE R-Y-B COLOUR CODED WIRING FOR CT/PT SECONDARIES.
16. ENTRY OF CABLE INTO THE BOX SHALL BE THROUGH GLANDS AND CHECK NUTS AND THERE SHALL BE NO ACCESS THROUGH ENTRY POINTS OF THE CABLE.
17. CABLE INSULATION PIERCING CONNECTOR TO BE USED FOR TAPPING POTENTIALS. (QTY. – 4 NOS.)
18. EARTHING BOLT 6x20mm SIZE WITH 2 NOS. WASHERS & 2 NOS. NUTS SHALL BE PROVIDED.
19. DANGER BOARD OF DIMENSION 80x130mm SHALL BE PROVIDED ON THE FRONT SIDE OF THE DOOR.

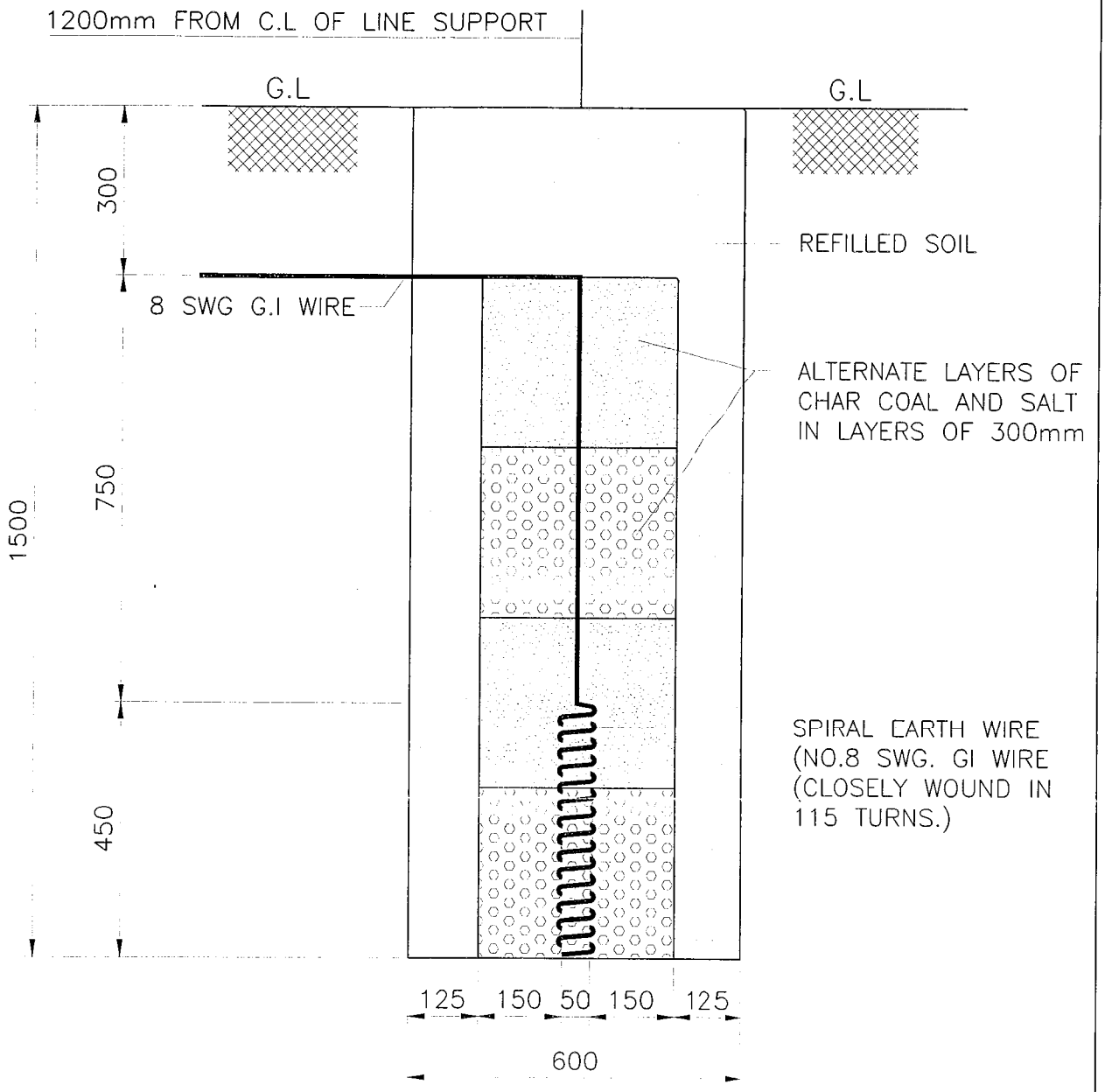




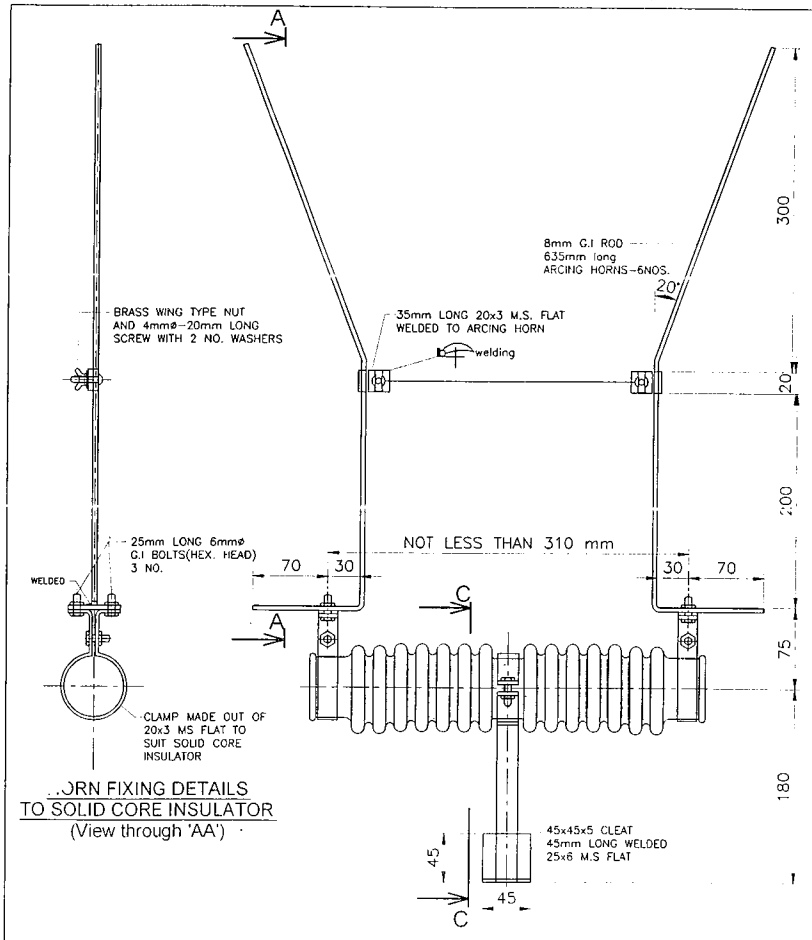
CONNECTOR



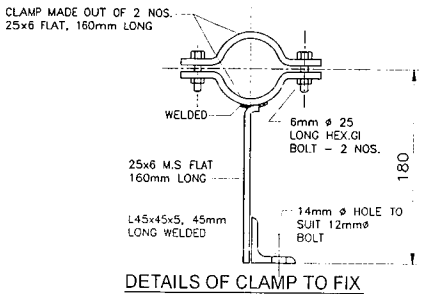
	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF 3 PHASE METER BOX WITH C.Ts, P.Ts AND BUS BAR ARRANGEMENT.	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/09 REV-002 DATED:24-11-2018
	SCALE: N.T.S		



	Signatures	All dimensions are in mm unless otherwise stated.	ಬಿಎಸ್ಕಂ BESCOM
Chd	AGM (QS&S)	DETAILS OF SPIRAL EARTH ELECTRODE	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/19 REV-002 DATED:24--11-2018
	SCALE: N.T.S		



..ORN FIXING DETAILS
TO SOLID CORE INSULATOR
(View through 'AA')



DETAILS OF CLAMP TO FIX
SOLID CORE INSULATOR
TO CROSS ARM
(View through 'CC')

BILL OF MATERIALS/SET

SL. NO.	DESCRIPTION	QTY.
1.	11KV CLASS SOLID CORE INSULATORS	3 NOS.
2.	G.I HORNS USING 8mm ø ROD AS DETAILS SHOWN THROUGH AA WITH CLAMPING ARRANGEMENT USING 20x3 M.S. FLAT AND G.I BOLTS.	6 SETS
3.	CLAMPS MADE OUT OF 25x6 M.S FLAT & L 45x45x5 CLEAT AS SHOWN IN DETAIL THROUGH CC WITH REQD. BOLTS	3 SETS
4.	P.G CLAMP ONE GROOVE SUITABLE TO 8 mm ø G.I ROD AND OTHER GROOVE SUITABLE TO 8 TO 10 mm ø ACSR CONDUCTOR.	6 NOS.

NOTES:-

1. THE DRAWING HAS BEEN PREPARED BASED ON WORK SHOP SAMPLE USED IN FIELD.
2. ALL METALLIC PARTS SHALL BE HOT DIP GALAVANISED.
3. FOR SOLID CORE INSULATOR REFER DRAWING NO:-BESCOM/GM/QS&S/29

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	DGM (QS&S)	11 KV HORN GAP FUSE USING SOLID CORE 11KV INSULATORS	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/21 REV-002 DATED:24-11-2018
SCALE : NTS			

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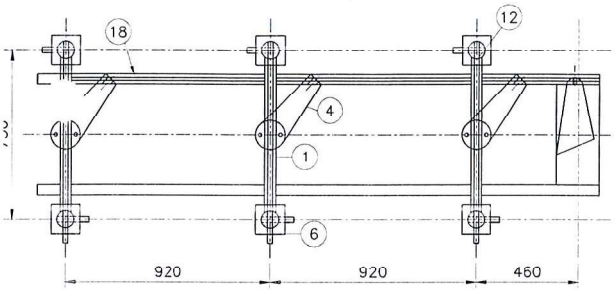
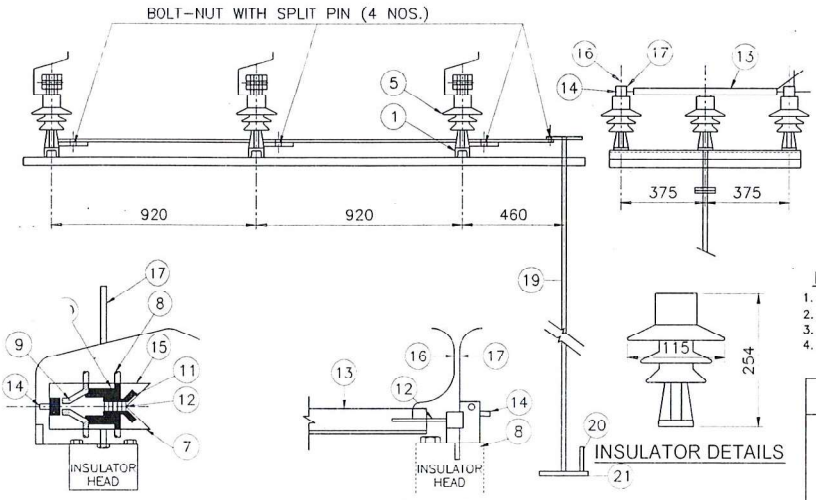


11KV 400A GOS (DOUBLE BREAK)



TOP DETAILS IN SECTIONAL ELEVATION

REAR SIDE VIEW

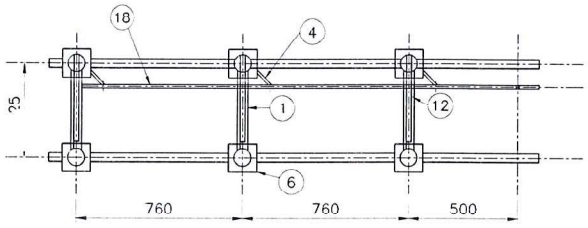
INSULATOR DETAILS

SL. NO.	DESCRIPTION	SIZE	SECTION IN mm	QUANTITY
1.	M.S CHANNEL	825mm	75x40x6	3 NO.
2.	GUN METAL BUSH (TOP) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	25mmø	3 NO.
3.	GUN METAL BUSH (BOTTOM) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	20mmø	3 NO.
4.	SPINDLE PLATE WITH SPINDLE	280mm	75x6mm	3 NO.
5.	11KV POST INSULATOR	–	–	9 NO.
6.	TOP PLATE	155mm	145x6mm	6 NO.
7.	CONTACT BOX (BOTTOM)	100mm L 3mm Th	42mm W	
8.	COPPER CONTACT PIN (TINNED)	8mm ROD	50mm L	24 NO.
9.	PHOSPHOR BRONZE COPPER STRIPS (TINNED)	110 (0.5Th.)	25mm W	48 NO.
10.	SPRING(STAINLESS STEEL)	25mm Long	10mmø	24 NO.
11.	COPPER CONTACT (TINNED)	90mm	35x6	12 NO.
12.	COPPER KNIFE (TINNED)	760mm	40x6	3 NO.
13.	MOVABLE ANGLE	580mm	45x45x5	3 NOS.
14.	LEADING FLAT, COPPER (TINNED)	190mm	40x6	6 NO.
15.	CONTACT BOX (TOP)	160mm	3mm Th. 32mm W	6 NO.
16.	MOVABLE ARCING HORN	440mm	10mmø	6 NO.
17.	FIXED ARCING HORN	300mm	10mmø	6 NO.
18.	HORIZONTAL G.I PIPE	2450mm	25mmø B-CLASS	1 NO.
19.	VERTICAL G.I PIPE	5400mm	25mmø B-CLASS	1 NO.
20.	HANDLE PIPE	500mm	25mmø B-CLASS	1 NO.
21.	LOCKING ARRANGEMENT	PLATES 6mm	210x90, 100x90 360x90, 300x50	4 NO.
22.	NUT & BOLTS 80 x 10mm – 24 NO, 25mm LONG– 5 NO, 30mm – 18 NO, 32mm LONG – 60 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			
23.	64 x 12mm – 4 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			

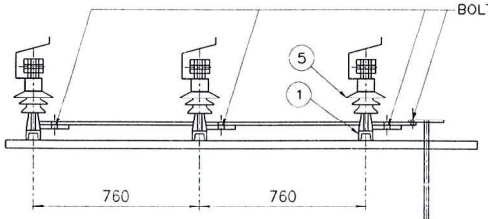
NOTES:–

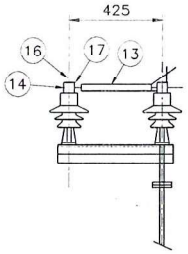
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. THE INSULATORS USED IN GOS SHALL BE GOT APPROVED BEFORE PLACING THE PURCHASE ORDER.
3. ALL COPPER PARTS ARE TO BE TIN PLATED.
4. ALL BOLT NUTS USE FOR OPERATING ANGLE SHALL BE WITH SPLIT PIN.

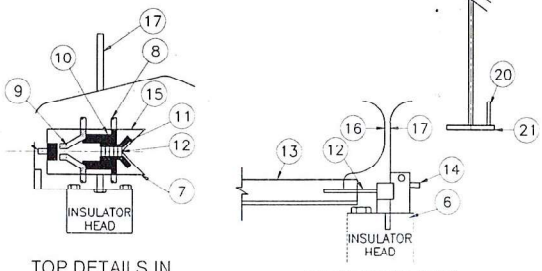
	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	11 KV, 400A DOUBLE BREAK ISOLATOR	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE N.T.S			DRG.NO.BESCOM/GM/QS&S/22 REV-002 DATED:24-11-2018



11KV 200A GOS (SINGLE BREAK)

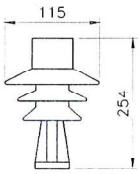






TOP DETAILS IN SECTIONAL ELEVATION

REAR SIDE VIEW



INSULATOR DETAILS

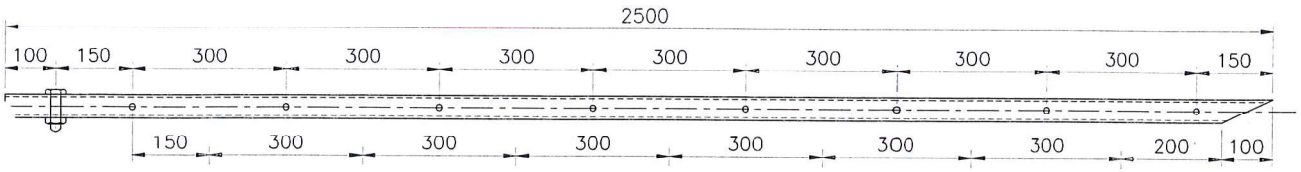
SL. NO.	DESCRIPTION	SIZE	SECTION IN mm	QUANTITY
1.	M.S CHANNEL	500mm	75x40x6	3 NOS.
2.	GUN METAL BUSH (TOP) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	25mmø	3 NOS.
4.	SPINDLE PLATE WITH SPINDLE	290mm	75x6mm	3 NOS.
5.	11KV POST INSULATOR	–	–	6 NOS.
6.	TOP PLATE	100mm	50x6mm	6 NOS.
7.	CONTACT BOX (BOTTOM)	110x16mm L.3mm Th	42mm W	3 NOS.
8.	COPPER CONTACT PIN (TINNED)	8mm ROD	50mm L	12 NOS.
9.	PHOISPHUR BRONZE COPPER STRIPS (TINNED)	100 (0.5Th.)	25mm W	12 NOS.
10.	SPRING(STAINLESS STEEL)	25mm Long	14G	12 NOS.
11.	COPPER CONTACT (TINNED)	90mm	25x6	6 NOS.
12.	COPPER KNIFE (TINNED)	460mm	35x6	3 NOS.
13.	MOVABLE ANGLE	400mm	45x45x5	3 NOS.
14.	LEADING FLAT, COPPER (TINNED)	190mm	25x6	6 NOS.
15.	CONTACT BOX (TOP)	160mm	3mm Th. 32mm W	6 NOS.
16.	MOVABLE ARCING HORN	440mm	8mmø	3 NOS.
17.	FIXED ARCING HORN	300mm	8mmø	3 NOS.
18.	HORIZONTAL G.I PIPE	2450mm	25mmø B-CLASS	1 NO.
19.	VERTICAL G.I PIPE	5400mm	25mmø B-CLASS	1 NO.
20.	HANDLE PIPE	500mm	25mmø B-CLASS	1 NO.
21.	LOCKING ARRANGEMENT	PLATES 6mm	210x90, 100x90 360x90, 300x50	4 NO.
22.	NUT & BOLTS 80 x 10mm – 24 NO, 25mm LONG– 5 NO, 30mm – 18 NO, 32mm LONG – 60 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			
23.	64 x 12mm – 4 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			

NOTES:–

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. THE INSULATORS USED IN GOS SHALL BE GOT APPROVED BEFORE PLACING THE PURCHASE ORDER.
3. ALL COPPER PARTS ARE TO BE TIN PLATED.
4. ALL BOLT NUTS USE FOR OPERATING ANGLE SHALL BE WITH SPLIT PIN.

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	11 KV. 200A SINGLE BREAK ISOLATOR	Approved: General Manager.(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/22 REV-002 DATED:24-11-2018
SCALE N.T.S			

(95)



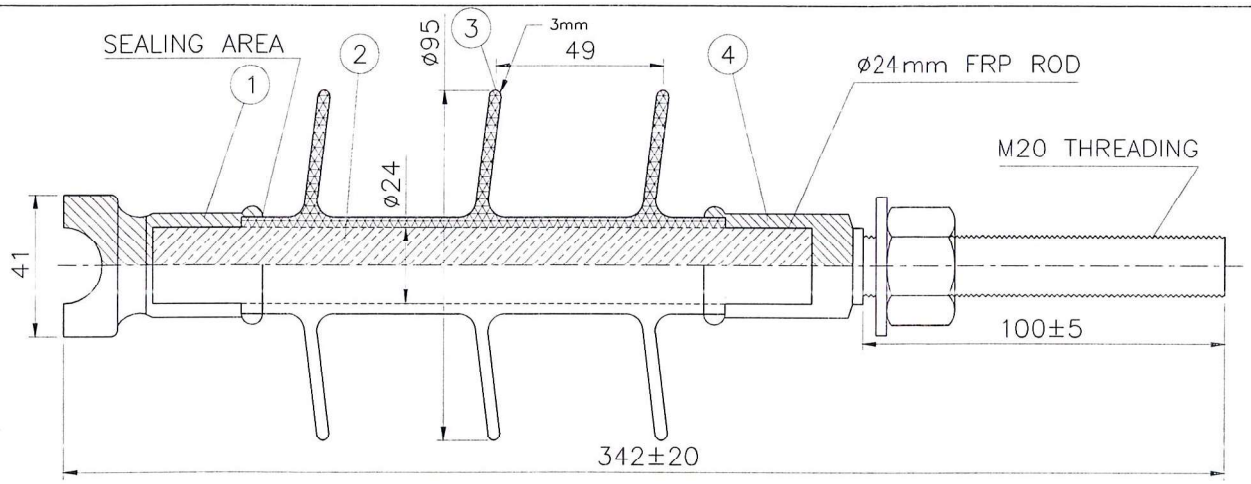
REF. 42mm DIA, 3.2mm THICKNESS CLASS B GI PIPE, 3.23Kg/Mtr. IS-1239
GI BOLT & NUT - IS-6089
ALL FERROUS PARTS TO BE GALVANISED AS PER IS-5358.
HEAVY GI WASHERS.

NOTES:-

1. ALL DIMENSIONS ARE IN mm.
2. 12mm DIA. 75mm LONG BOLT WITH MAIN NUT LOCKING NUT & 3 NOS. 3mm THICK WASHERS.

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF G.I GROUNDING PIPE	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/27 REV-002 DATED:24-11-2018
	SCALE: N.T.S		

96



ITEM	DESCRIPTION	MATERIAL	QTY	REMARKS
1	TOP METAL FITTING	SGCI/FORGED	1 NO	HDG
2	CORE ROD	FIBERGLASS	1 NO	24mmø
3	POLYMER HOUSING	SILICONE RUBBER	–	
4	BOTTOM METAL FITTING	SGCI/FORGED	1 NO	HDG

TECHNICAL CHARACTERISTICS:

DIMENSIONS:	
1. CREEPAGE DISTANCE(MINIMUM)	320mm
2. ARCING(MINIMUM)	167mm
3. No OF ø95mm SHEDS	3

MECHANICAL CHARACTERISTICS:	
1. MIN FAILING LOAD	5kN

ELECTRICAL CHARACTERISTICS:	
1. NOMINAL SYSTEM VOLTAGE	11KV
2. HIGHEST SYSTEM VOLTAGE	12KV
3. SYSTEM FREQUENCY	50HZ
4. WET 1 MINUTE POWER FREQUENCY WITHSTAND VOLTAGE	35kV(rms)
5. DRY 1 MINUTE POWER FREQUENCY WITHSTAND VOLTAGE	40kV(rms)
6. DRY LIGHTNING IMPULSE WITHSTAND VOLTAGE	75kVp
7. VISIBLE DISCHARGE TEST VOLTAGE	9kV(rms)

NOTES:
1. INSULATOR CONFORMS TO IEC: 61109-2008
   IS: 2488-1974
2. GALVANISATION CONFORMS TO IS: 2679-1985

	Signatures
Chd	AGM (QS&S)
Sub	DGM (QS&S)

SCALE: N.T.S

All dimensions are in mm unless otherwise stated.

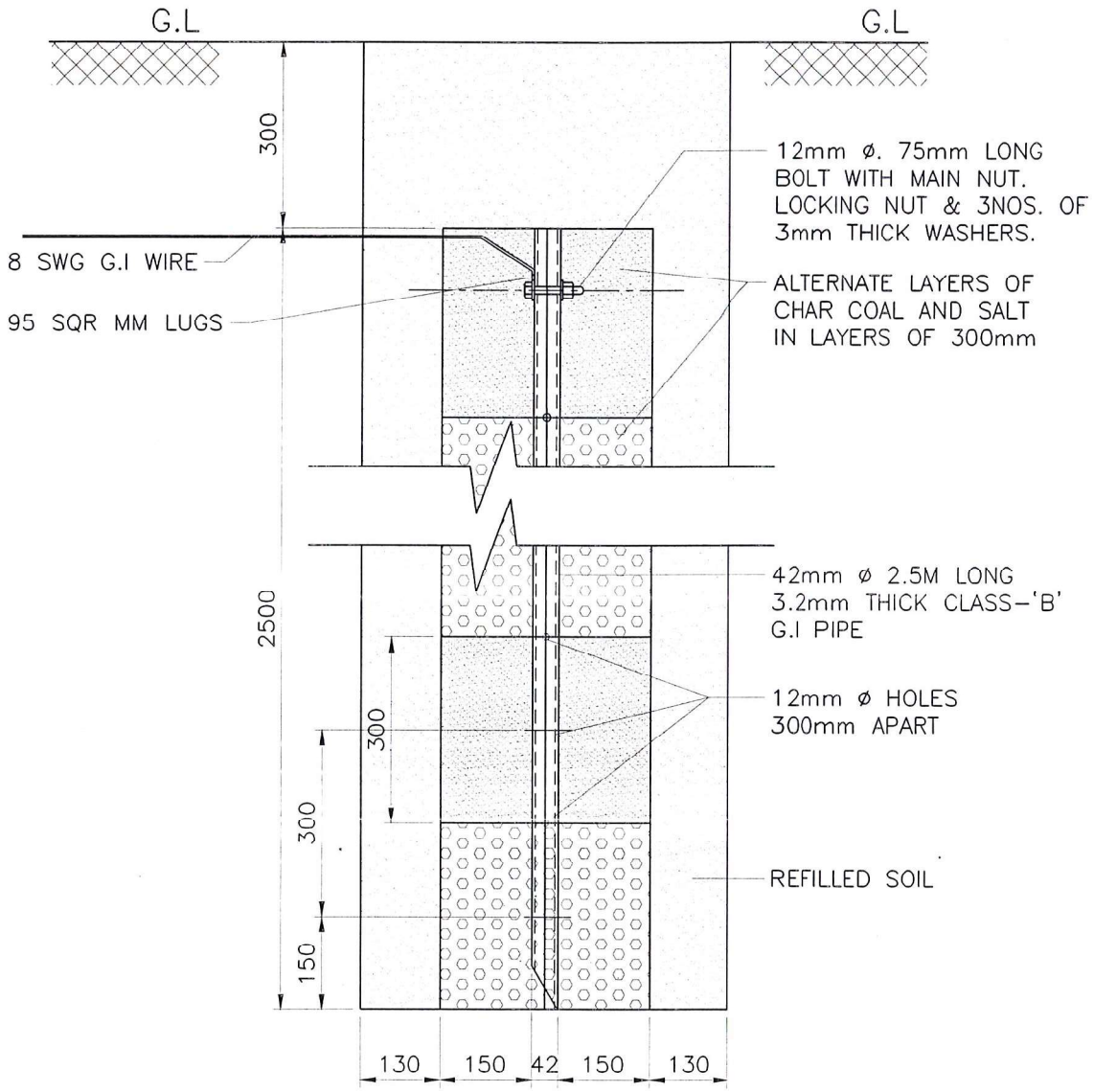
11kV 5KN COMPOSITE PIN INSULATOR

ಬೆಸ್ಕಾಂ
BESCOM

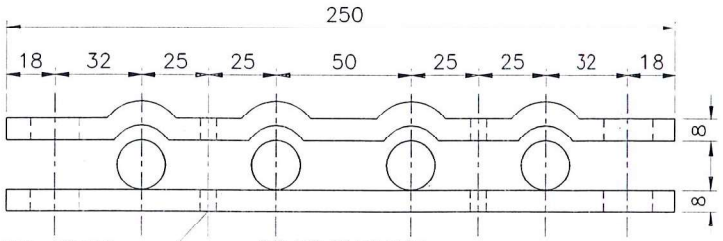
Approved:

General Manager,(Elec.)
QS&S

DRG.NO.BESCOM/GM/QS&S/28
REV-002 DATED:24-11-2018

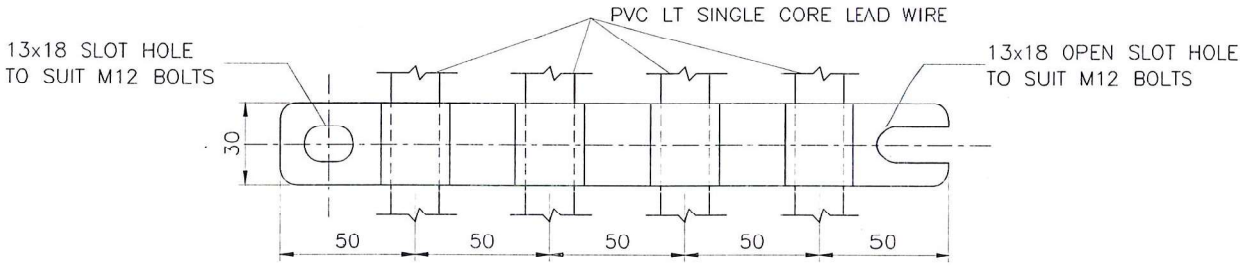


	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	DETAILS OF PIPE EARTH ELECTRODE FOR DISTRIBUTION SYSTEMS	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/34 REV-002 DATED:24-11-2018
	SCALE: N.T.S		



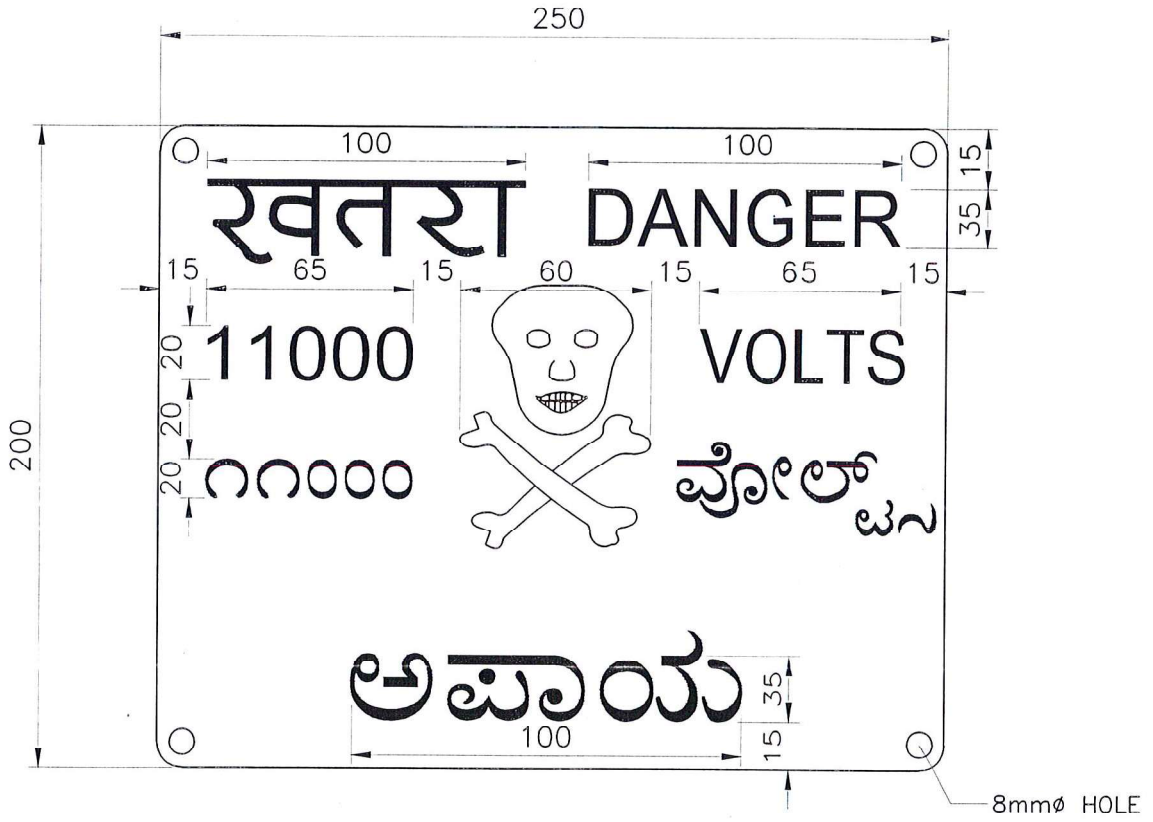
M7 HOLE TO SUIT M6 DIA. BOLTS

ELEVATION



PLAN

	Signatures	All dimensions are in mm unless otherwise stated.	ಬಿಎಸ್ಕಾಂ BESCOM
Chd	AGM (QS&S)	PVC SPACER FOR POLE MOUNTED TRANSFORMER CENTRE WIRING	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/38 REV-002 DATED:24-11-2018
	SCALE: N.T.S		

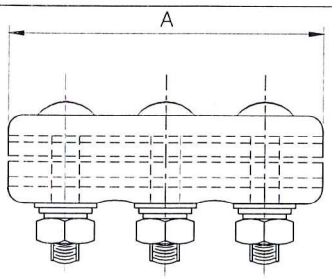


NOTES:-

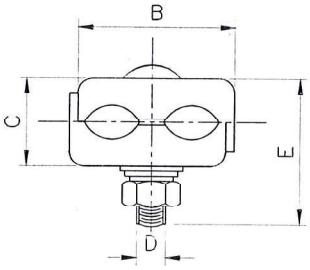
1. THE PLATE SHALL BE MADE FROM MILD STEEL OF MINIMUM THICKNESS 1.6mm.
2. THE PLATE SHALL BE VITREOUS ENAMELLED WHITE WITH LETTERS, FIGURES AND THE CONVENTIONAL SKULL AND BONES IN SIGNAL RED COLOUR.
3. ALL LETTERING SHOULD BE CENTRALLY SPACED.
4. THE CORNERS OF THE PLATE SHOULD BE ROUNDED OFF.
5. THE REAR SIDE OF THE BOARD SHALL ALSO BE ENAMELLED.

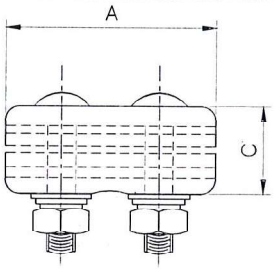
	Signatures	All dimensions are in mm unless otherwise stated.	ಬಿವಿಕಂ BESCOM
Chd	AGM (QS&S)	DETAILS OF DANGER BOARD FOR 11KV INSTALLATIONS	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/40 REV-002 DATED:24-11-2018
SCALE: N.T.S			

100



THREE BOLT TYPE





TWO BOLT TYPE

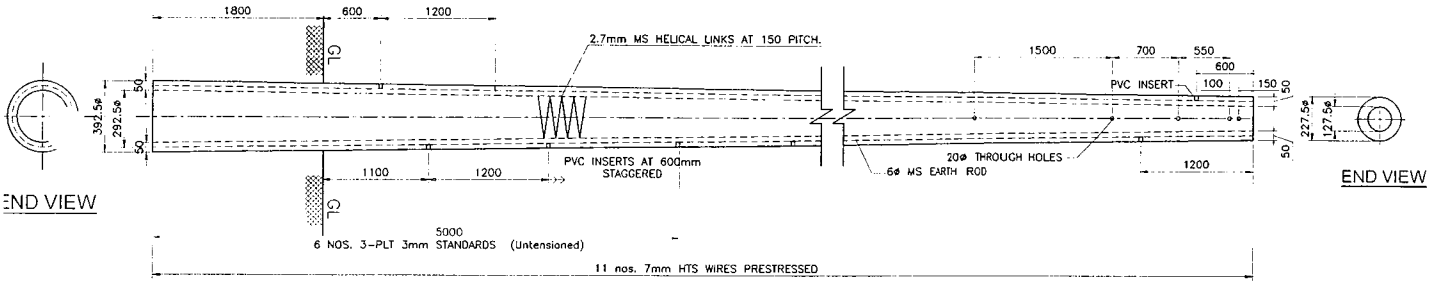
SL. NO.	SIZE OF CONDUCTOR	DIMENSIONS							NO. OF BOLTS
				A	B	C	D	F	
1.	240 SQ.mm LT LEAD/RABBIT	20.05	10.05	140	78	42	16	78	3
2.	185 SQ.mm LT LEAD/RABBIT	14.35	10.05	127	65	36	12	57	3
3.	95 SQ.mm LT LEAD/RABBIT	12.70	10.05	125	58	35	12	55	2
4.	50 SQ.mm LT LEAD/RABBIT	9.15	10.05	99	48	22.2	12	44	2

NOTES:-

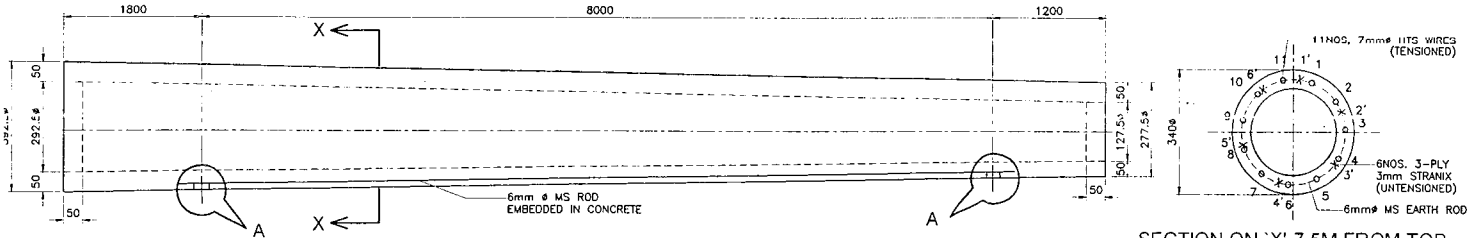
1. CLAMP BODY HIGH STRENGTH, CORRISION-RESISTANT, ALUMINIUM WITH EC GRADE
2. DIN.934 DACROMET

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	P.G CLAMPS SUITABLE FOR A.C.S.R CONDUCTORS	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/43 REV-002 DATED.24-11-2018

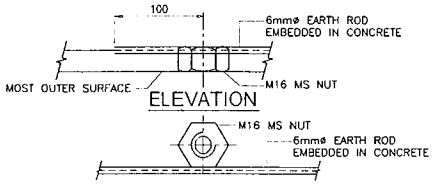
101



ELEVATION



SECTION ON `X'-7.5M FROM TOP



ENLARGED SECTION SHOWING EARTHING ROD ARRANGEMENTS

DETAILS AT `A'

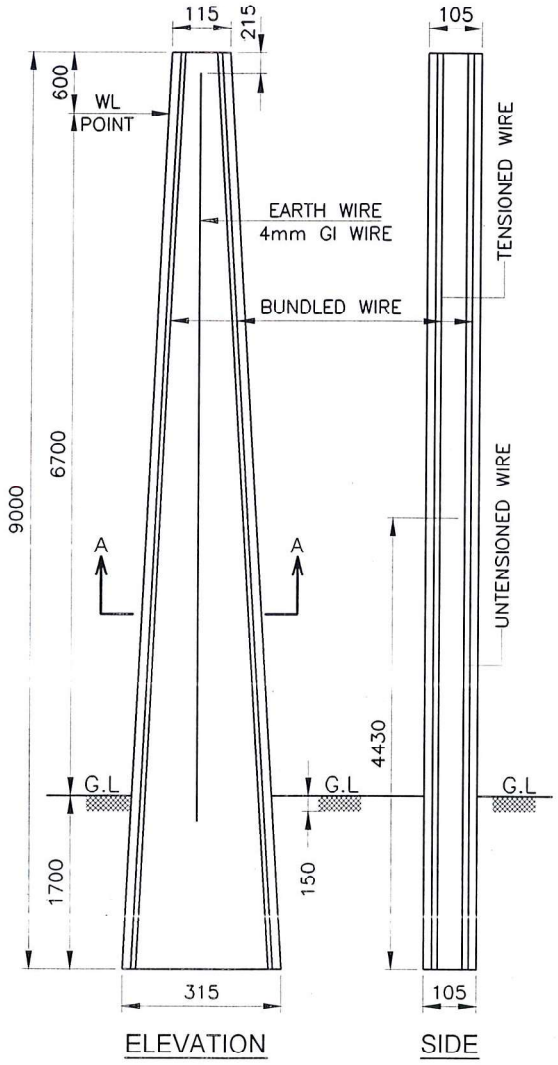
NOTES:-

1. 7mm HTS WIRES ARE INDENTED PC WIRES TO IS:6003-1953.
2. MS REINFORCEMENTS ARE TO IS:432 PL1-1982
3. GRADE OF CONCRETE F=52 Kg/Sq.Cm (CONTROLLED CONCRETE)
4. TRANSFER STRENGTH OF CONCRETE TO BE MINIMUM 306 Kg/Sq.Cm.
5. MINIMUM CLEAR COVER FOR TENSIONED & UNTENSIONED WIRE IS 20mm
6. 6mm MS EARTH WIRE TO BE WELDED TO M16 NUT AT 2 LOCATIONS AS SHOWN.
7. PVC INSERTS AT 600 CRS STANDARD ON OPPOSITE SIDES SHOWN.
8. CG. OF POLE IS 6M FROM BOTTOM.

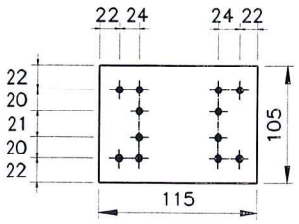
INDEX OF MATERIALS

SL. NO.	DESCRIPTION	WEIGHT(Kg)
1.	CONCRETE 0.4416 - 2500Kg/m	1104.0
2.	3x3 PLY. HTS WIRES TO IS:6006-1983	3.0
3.	7mm HTS WIRES TO IS:6006-1983	36.8
4.	2.7mm HELICAL	2.8
5.	6mm EARTHING TOD TO IS:2062 GRADE 'A'	1.8

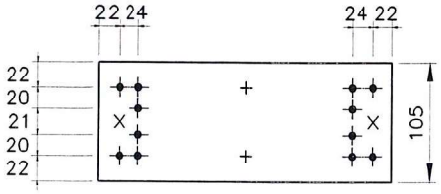
	Signatures	All dimensions are in mm unless otherwise stated.	
Chd	AGM (QS&S)	11.0M LENGTH PRESTRESSED CONCRETE SPUN POLE	BESCOM Approved General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
	SCALE: N.T.S		DRG.NO.BESCOM/GM/QS&S/45 REV-002 DATED:24-11-2018



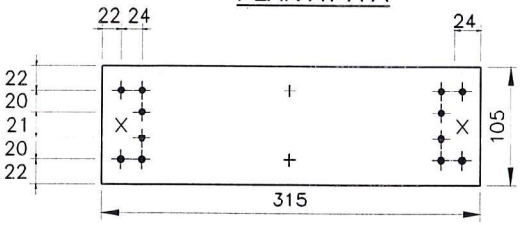
ELEVATION SIDE



PLAN AT TOP



PLAN AT A-A



PLAN AT BOTTOM

- • DENOTES TENSIONED WIRES
- X DENOTES UNTENSIONED WIRES
- \+ POSSIBLE POSITION OF EARTH WIRE

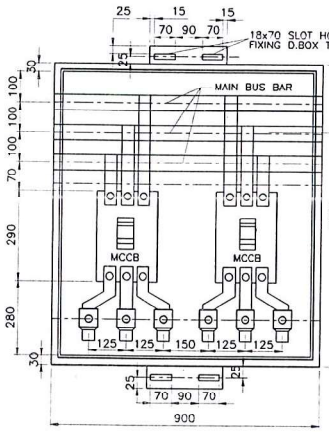
TECHNICAL GUARANTEE PARTICULARS:

SECTION	
CONCRETE QUANTITY PER POLE	0.203 Cu.M
CONCRETE GRADE	M-40
STEEL QUANTITY PER POLE	14.0 Kg.
OVERALL LENGTH SUPPORT	9.0 Mtr
PLANTING DEPTH	1.7 Mtr
DIAMETER OF PRESTRESSING WIRE	4mm
NUMBER OF TENSIONED WIRES	12 NOS
NUMBER OF UNTENSIONED WIRES	2 NOS
PRE-TENSIONED APPLIED TO EACH 4mm WIRE	1760 Kgs
MINIMUM CUBE STRENGTH OF CONCRETE AT 28 DAYS	420 Kg/Cm3
CLEAR COVER WIRES	20mm
FACTOR OF SAFETY	2.5
WORKING LOAD	200 Kgs
ULTIMATE LOAD	500 Kgs
WEIGHT OF POLE	480 Kgs.
LOAD APPLICATION AT A POINT FROM THE TOP	600 mm
UNTIMATE TENSION STRENGTH FOR 4mm WIRE	17500 Kg/Cm2

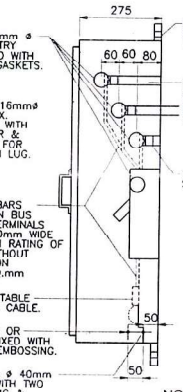
NOTES:-

1. FOR HOLDING PART LENGTH UNTENSIONED WIRES IN POSITION, 4mm ø M.S STIRRUPS MAY BE USED WITH SUITABLE SPACING.
2. IF ANY PRACTICAL DIFFICULTY IS EXPERIENCED IN USING PART LENGTH UNTENSIONED WIRES, FULL LENGTH WIRES MAY BE USED INSTEAD. BUT THE TENSION IN THESE. WIRES SHOULD NOT EXCEED 9% OF THEIR U.T.S VALUE HOWEVER IT MAY BE NOTED THAT USE OF PART LENGTH UNTENSIONED WIRES WILL BE MORE ECONOMICAL.
3. FOR MORE DETAIL REFER I.S.1678.

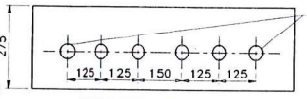
	Signatures	All dimensions are in mm unless otherwise stated.	ಬೆಸ್ಕಂ BESCOM
Chd	AGM (QS&S)	REINFORCEMENT DETAILS OF 9.0 M 200 Kg. PRESTRESSED CEMENT CONCRETE POLE FACTOR OF SAFETY=2.5 (P.S.C.C)	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/50 REV-002 DATED:24-11-2018
	SCALE: N.T.S		


25
15
15
70 90 70
18x70 SLOT HOLES FOR FIXING D.BOX TO POLE CLAMPS.
4 HOLES OF 50mm ø FOR CABLE ENTRY ON EITHER SIDED WITH RUBBER/FIBRE GASKETS.
MAIN BUS BAR
HOLES TO SUIT 16mmø 40mm LONG HEX. G.I BOLT & NUT WITH PLAN G.I WASHER & SPRING WASHER FOR FIXING ALUMINUM LUG.
ALUMINUM BUS BARS CONNECTION MAIN BUS BARS TO MCCBTERMINALS VARIES 25 TO 50mm WIDE DEPENDING UPON RATING OF SWITCH USED WITHOUT REDUCING SECTION AREA OF 200 SQ.mm
COPPER LUG SUITABLE FOR 185 SQ.mm CABLE.
2 NOS. 25mm ø OR SQUARE PLATE FIXED WITH TWO RIVETS OF EMBOSSING.
2 NOS. OF 8mm ø 40mm LONG G.I BOLT WITH TWO NUTS, ONE SPRING & TWO PLAIN WASHERS FOR EARTHING.
MCCB
MCCB
125 125 150 125 125
70 90 70
900
1000
30
100 100 100 70 290 280 30
25

FRONT VIEW WITHOUT DOORS


275
60 60 80
2 of 260mm LONG 76x6 FLAT WELDED TO BOX
2mm M.S SHEET SUPPORT TO BUS BAR INSULATORS TO KEEP BUS BARS AT DIFFERENT LEVELS.
1.1KV CLASS BUS SUPPORT INSULATOR
50
50

SIDE VIEW



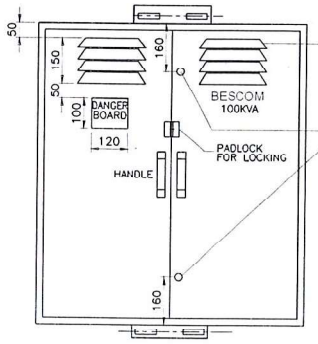
VIEWED FROM BOTTOM

BILL OF MATERIALS

SL. NO	PARTICULARS	QUANTITY	REFERENCE STANDARD
1	MOLDED CASE CIRCUIT BREAKER 60 KA (REPUTED MAKE) 160A	2 NOS.	IS-8828 & IS-13947
2.	EC GRADE EQ ALUMINUM BUS BARS WITH PVC INSULATED TOUCHNED/COMPOUND INSULATION COATING a) MAIN BUS BARS 50x6mm b) CONNECTION LINKS 20x18mm	 3 NOS. 12 NOS.	
3.	BUS SUPPORT INSULATORS 1.1KV CLAES	12 NOS.	
4.	M.S SHEET 2mm		
5.	PAINT: ADMIRAL GREY		IS-5
6.	DANGER BOARD 120x10mm	1 NO.	IS-2551
7.	BRASS BOLTS & NUTS FOR TERMINATION	12 NOS.	
8.	ALU-CU. BI METALLIC WASHERS	24 NOS.	
9.	SPRING WASHERS	12 NOS.	

NOTES:-

1. ALL DIMENSIONS ARE IN mm ONLY.
2. BOX SHALL BE MADE OUT OF 2mm SHEET, PROTECTION AS PER IP-53.
3. THE DOOR SHALL HAVE INTERVAL LOCKING ARRANGEMENT WITH SPRING LOADED LATCH OPERATED BY A COMMON KEY FOR ALL THE BOXES.
4. EARTHING MUST BE DISTINCTLY INDICATED BY METALLIC LABEL OR EMBOSSED.
5. DIMENSIONS ARE CRITICAL, SUBJECT TO SLGHT ALTERATIONS.
6. CABLE ENTRIES AND OUTLETS ARE OF 50mm ø HOLES COVERED WITH 2mm THICK M.S. SHEET SQUARE PLATES.
7. RIGOROUS RUST PROOFING PROCESS (3 IN 1 TREATMENT), DEGREASING, DERUSTING AND PHOSPHATING SHALL BE CARRIED OUT ON THE METAL BEFORE AND AFTER FABRICATION OF THE BOX AND BEFORE SPRAY PAINTING.
8. ALUMINUM LUGS SHOWN ARE NOT IN THE SCOPE OF SUPPLY.
9. THE DOORS SHALL BE OF SELF CLOSING TYPE WITH SPRING ARRANGEMENT.



FRONT VIEW

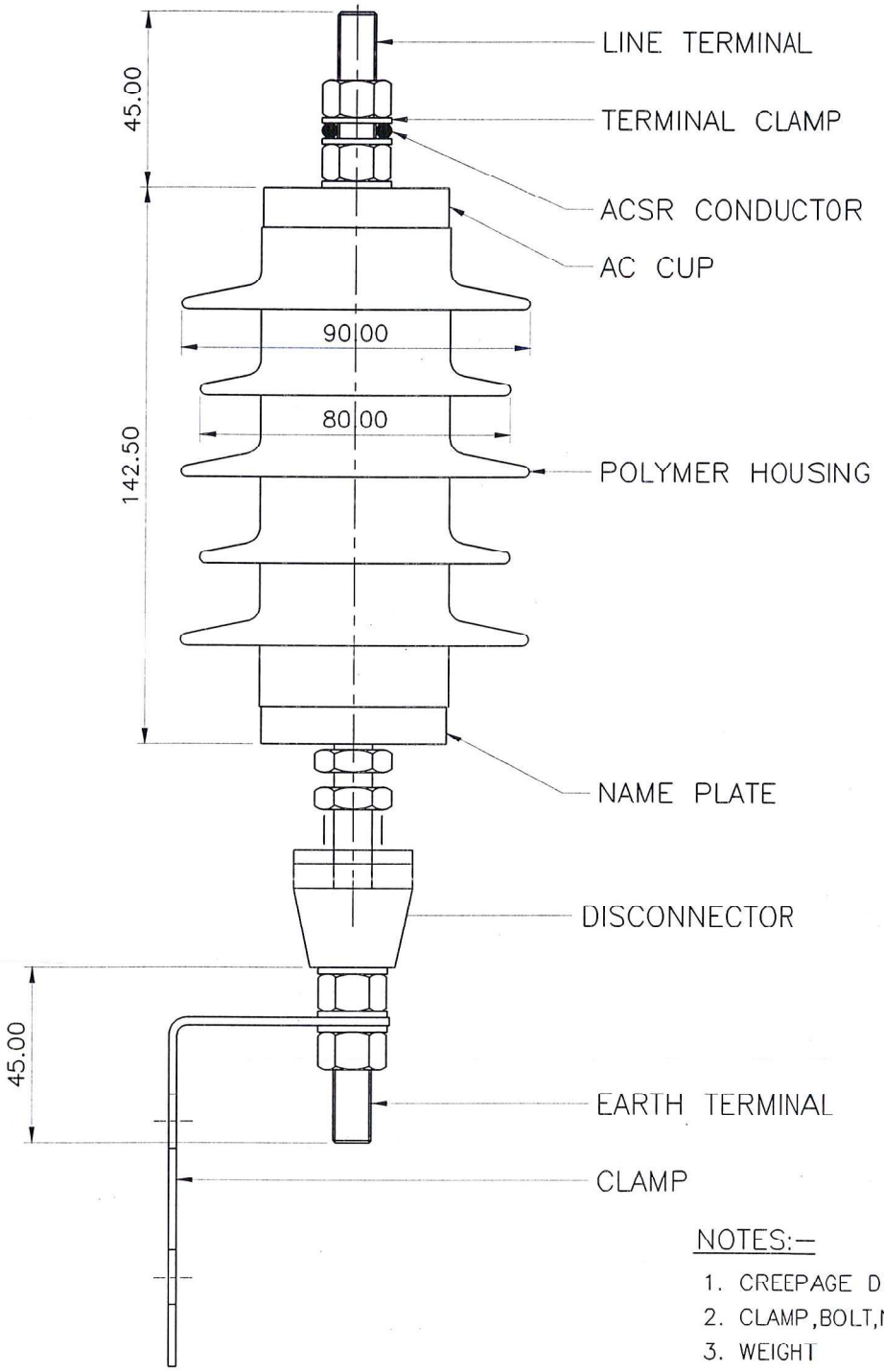
MANUFACTURES'S NAME & ADDRESS

KVA TYPE
VOLTS P.ONO.
AMPS. S.NO.

TYPICAL NAME PLATE DETAILS

	Signatures	All dimensions are in mm unless otherwise stated.	ಬಿಎಸ್ಕಾಂ BESCOM
Chd	AGM (QS&S)	DETAILS OF L.T DISTRIBUTION BOX SUITABLE FOR 100 KVA TRANSFORMERS USING MCCB	Approved: General Manager.(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/58 REV-002 DATED:24-11-2018
	SCALE N.T.S		

(104)



NOTES:—

1. CREEPAGE DISTANCE :310mm
2. CLAMP,BOLT,NUT & WASHERS :HDG
3. WEIGHT :860Gms

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	10KV 5KA POLYMER LIGHTNING ARRESTER WITH GROUND DISCONNECTOR	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/60 REV-002 DATED:24-11-2018
SCALE: N.T.S			